EMC Enterprise Storage

EMC Fibre Channel Disk-Array Processor Enclosure (DPE) Rackmount FC4500

HARDWARE REFERENCE

P/N 014002901-04

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Preface

This manual describes how to install the EMC Fibre Channel Disk-Array Processor Enclosure (DPE) Rackmount Model FC4500, and how to replace and add customer-replaceable units (CRUs).

If you will install and service the rackmount DPE, you should read this manual. After reading it, you will be able to install a rackmount DPE, replace any CRUs that may fail, and upgrade a rackmount DPE by adding disk modules and redundant CRUs.

How This Manual Is Organized

Chapter 1	Introduces the rackmount DPE's components.
Chapter 2	Explains requirements and describes how to install the rackmount DPE and cable it to the server and to rackmount Disk Array Enclosures (DAEs).
Chapter 3	Describes how to replace CRUs such as disk modules.
Appendix A	Lists the rackmount DPE's technical specifications.
Glossary	Defines terms used in the Fibre Channel environment.

Related Documentation

Other EMC publications include:

- *EMC Fibre Channel Disk-Array Enclosure (DAE) Rackmount Hardware Reference* (P/N 014002591).
- *DC Standby Power Supply (SPS) Hardware Reference* (P/N 014002887).

Conventions Used in This Manual

EMC uses the following conventions for notes, cautions, warnings, and danger notices.

A note presents information that is important, but not hazard-related.

CAUTION

A caution contains information essential to avoid damage to the system or equipment. The caution may apply to hardware or software.

WARNING

A warning contains information essential to avoid a hazard that can cause severe personal injury, death, or substantial property damage if you ignore the warning.

DANGER

A danger notice contains information essential to avoid a hazard that will cause severe personal injury, death, or substantial property damage if you ignore the warning.

EMC uses the following type style conventions in this guide:

Boldface	Specific filenames or complete paths. Window names and menu items in text. Emphasis in cautions and warnings.
Italic	Introduces new terms or unique word usage in text. Command line arguments when used in text.
`Fixed space`	Examples of specific command entries that you would type, displayed text, or program listings. For example: `QUERY [CUU=`*`cuu`*`|VOLSER=`*`volser`*`]`
Fixed italic	Arguments used in examples of command line syntax.

1

About the Rackmount Disk-Array Processor Enclosure

Topics in this chapter include:

- Introduction 1-2
- DPE Components 1-4
- Link Control Cards (LCCs) 1-11
- Redundancy in Configurations 1-17

Introduction

The DPE is a highly available, high-performance, high-capacity, disk-array storage system that uses a Fibre Channel Arbitrated Loop (FC-AL) as its interconnect interface. Its modular, scalable design provides additional disk storage as your needs increase.

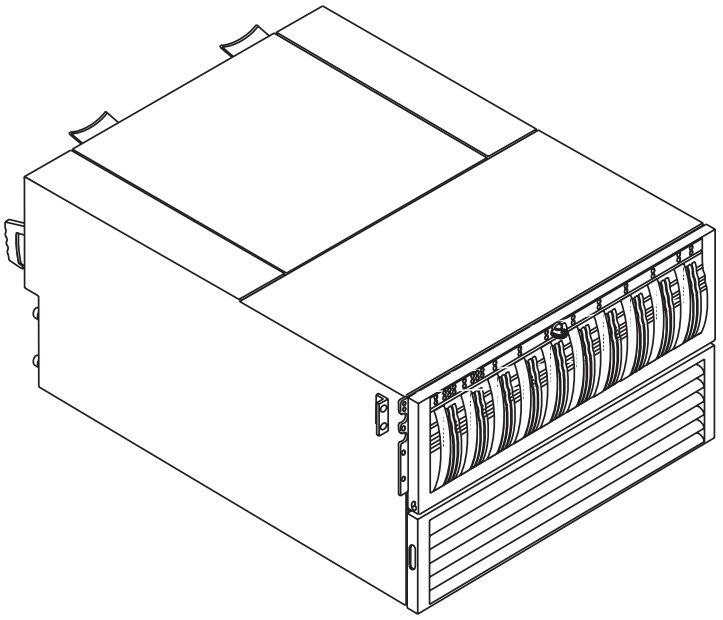


Figure 1-1 DAE

Using its interface, with simple FC-AL serial cabling, the FC4500 DPE can support up to 11 DAEs A DAE is a basic enclosure without a storage processor (SP). The FC4500 and 11 DAEs support up to 120 disk modules in a single disk-array file storage system.

You can place the DAEs in the same cabinet as the DPE, or in one or more separate cabinets. The DPE connects to the external Fibre Channel environment using GBIC connectors on the storage processor. High-availability features are standard.

The EMC Access Logix™ option provides Storage Group functionality for the FC4500 DPE.

DPE Components

The DPE components include:

- A sheet-metal enclosure with a midplane, front door, and SP fan pack cover
- One or two SPs
- One or two link control cards (LCCs)
- Up to ten disk modules
- One or two power supplies
- One drive fan pack
- One SP fan pack

Any unoccupied slot (SP, LCC, disk module, or power supply) has a filler module to maintain air flow and compliance with electromagnetic interference (EMI) standards.

The SPs, LCCs, disk modules, power supplies, fan packs, and filler modules are customer-replaceable units (CRUs), which you can add or replace without tools while the DPE is powered up.

The high-availability features for a DPE include:

- Second SP and LCC
- Second power supply
- Standby power supply (SPS) (See "Related Documentation" on page xi.)

A second SP (with required second LCC) provides continued access to the DPE and any connected DAEs if the first SP or LCC fails. The second SP can improve performance and connects easily to a second server.

The disk drives are FC-AL compliant and support dual-port FC-AL interconnects through the two LCCs and their cabling.

Enclosure

The enclosure is a sheet-metal housing with a front panel, a midplane, front door, and slots for the SPs, LCCs, disk modules, power supplies, and fan packs.

The following figures show the DPE components. Details on each component follow the figures. If the enclosure provides slots for two

identical components, the component in slot A is called *component-name* A. If there is a second component, it is in slot B and is called *component-name* B, as follows.

Component	Name in Slot A	Name in Slot B
SP	SP A	SP B
LCC	LCC A	LCC B
Power supply	PS A	PS B

If you have one power supply, it can be in either slot A or slot B. If you have one SP and one LCC, they can be in either slot A or B, but not mixed.

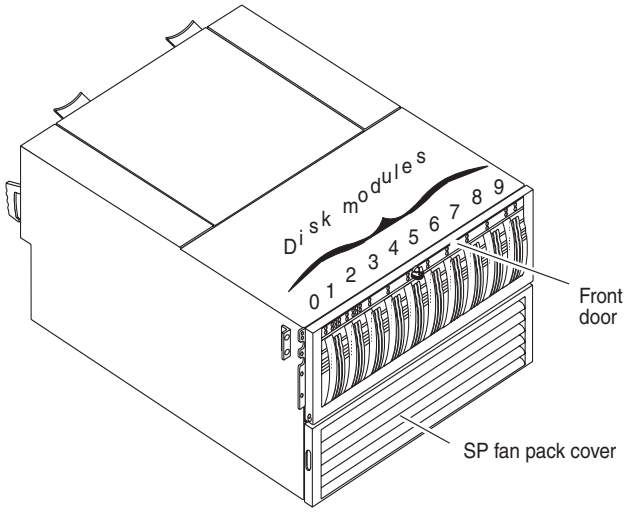


Figure 1-2 DPE Front View

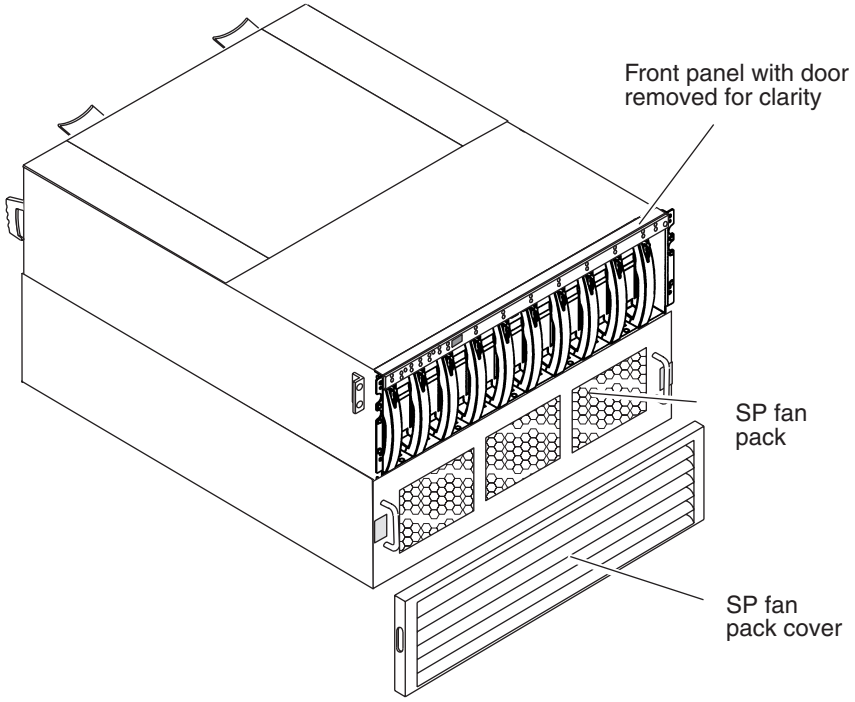


Figure 1-3 DPE Front View with SP Fan Cover and Door Removed

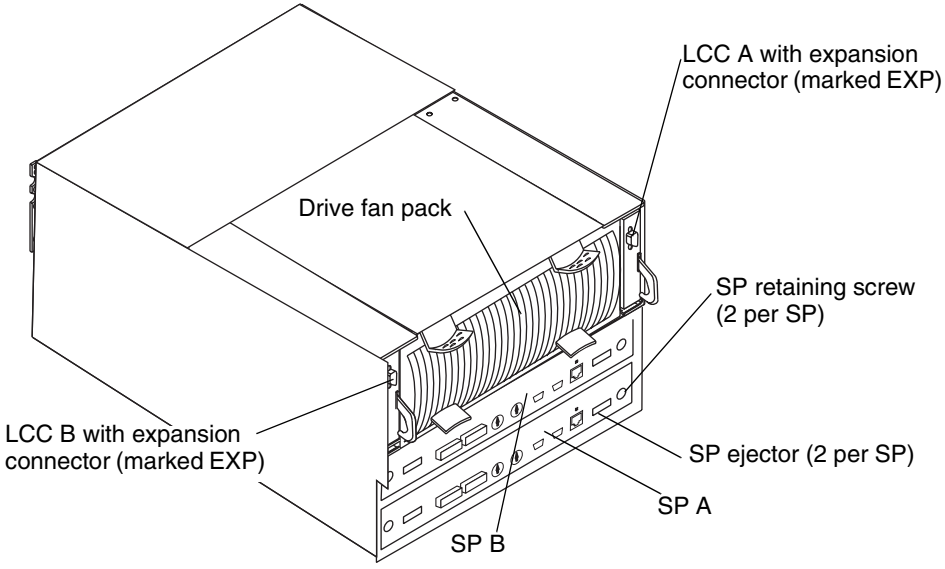

LCC A with expansion connector (marked EXP)
Drive fan pack
SP retaining screw (2 per SP)
LCC B with expansion connector (marked EXP)
SP ejector (2 per SP)
SP A
SP B

Figure 1-4 DPE Back View

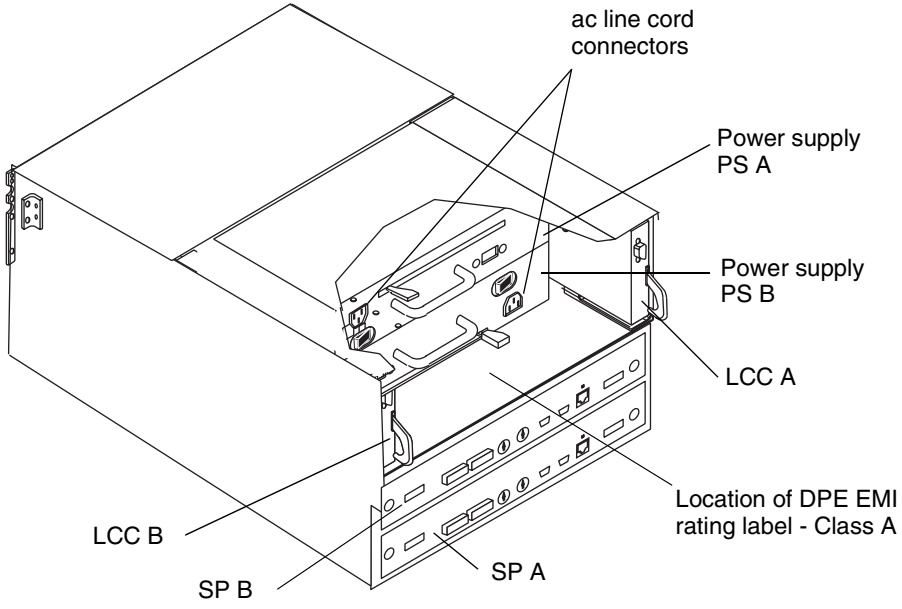
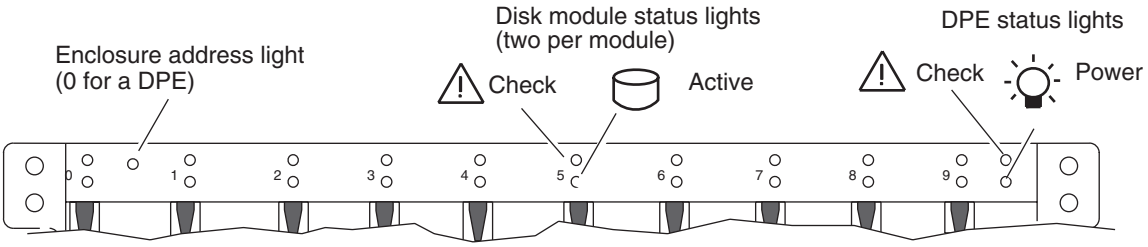


Figure 1-5 DPE Back View with Drive Fan Pack Removed

SP A works with LCC A to run SP A's disk modules; SP B works with LCC B to run SP B's disk modules.

Front Panel



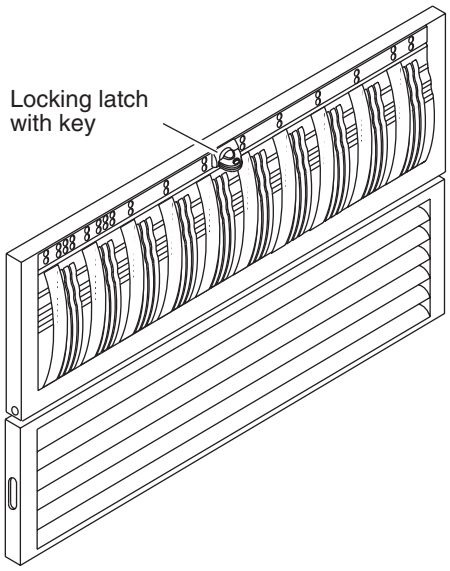
The front panel contains the enclosure address (EA) light, two status lights for each disk module slot, and two DPE status lights. All lights are visible with the front door closed.

The enclosure address light displays the enclosure address setting for the DPE, which is always 0. This address cannot be changed.

The DPE status lights are described in the "Monitoring DPE status" section in Chapter 3.

Midplane

The midplane distributes power and signals to all the enclosure components. All CRUs except the fan packs plug directly into midplane connectors.



The front door must be closed for the DPE to be EMI compliant. Opening the door to access the disk modules is a service procedure.

Figure 1-6 Front Door

The front door has a locking latch and an EMI shield. The latch is a push button with a removable locking key that you can use in any DPE or DAE. When the door is open, you can remove or install disk modules.

Storage Processors (SPs)

The SP is the DPE's intelligent component. It defines the DPE and differentiates the DPE from a DAE. An SP is a printed-circuit board with dual in-line memory modules (DIMMs), a bezel with status lights, and securing latches. The following figure locates the SP ports, the status lights, the location of the DIMMs, and the FC-AL ID rotary switches.

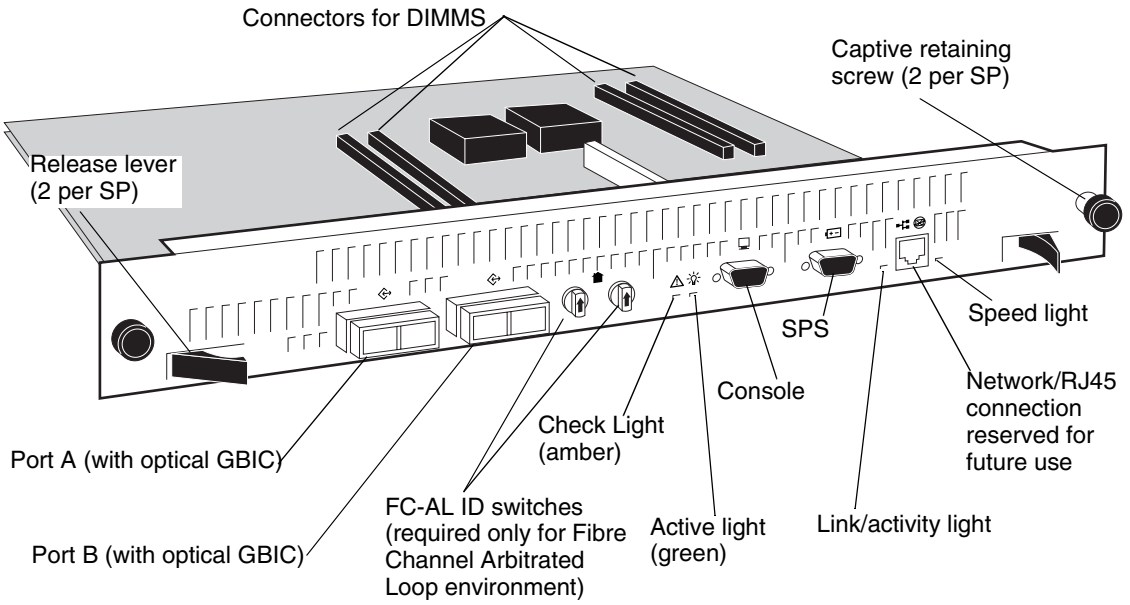

Connectors for DIMMS
Captive retaining screw (2 per SP)
Release lever (2 per SP)
Speed light
SPS
Console
Network/RJ45 connection reserved for future use
Check Light (amber)
Port A (with optical GBIC)
FC-AL ID switches (required only for Fibre Channel Arbitrated Loop environment)
Active light (green)
Link/activity light
Port B (with optical GBIC)

Figure 1-7 SP Back Panel

As shown in the figure, the SP has 4 connectors for DIMMs that comprise both read and write caches. These DIMMs come in 128-, 256-, or 512-Mbyte capacity. Memory allocation is handled by Navisphere® Manager or another Navisphere array management utility.

When the DPE is configured to operate in a fabric environment, only one of the SP ports (A or B) can be used to connect to the external Fibre Channel environment.

The SP has two Fibre Channel ports (A and B) referred to as the SP front end, for connecting to the external Fibre Channel environment. It also has two rotary switches for setting the FC-AL address ID when operating in a Fibre Channel Arbitrated Loop environment.

The SP connects to disk modules and to its corresponding LCC via an internal FC-AL. SP A connects to LCC A, and SP B to LCC B. The SP-LCC interface is called the SP back end.

The SP also has an Console connector (with a terminal icon), a connector for communication with the standby power supply, marked SPS, and a LAN connection. Each SP has four status lights

visible from the back of the DPE. For a definition of these light colors, see the "Monitoring DPE Status" section in Chapter 3.

If a DPE has one SP, you can install a second one while the DPE is running.When both SPs are installed, you can replace either SP while the DPE is running. You should never attempt to replace any of the SP's components, except the memory modules and GBICs.

Link Control Cards (LCCs)

A link control card (LCC) is a CRU in an enclosure that connects Fibre Channel signalling to the disk modules. The LCC provides:

- Fibre channel connectivity between the SP, disks, and other enclosures
- Bypass capability for faulted or missing units
- Monitor and control of the enclosure elements

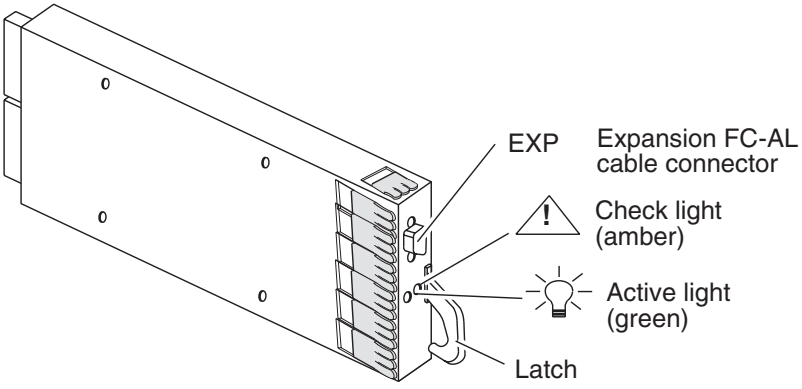


Figure 1-8 LCC

Each LCC independently monitors the environmental status of the entire DPE, using a microcomputer-controlled CRU monitor. The CRU monitor communicates status to the SP server using special protocols. These protocols let the SP poll DPE status and send commands that control the port LCC bypass circuits and the disk-module check lights.

Each LCC has two status lights visible from the back of the DPE. For definitions of these light colors, see the "Monitoring DPE Status" section in Chapter 3.

A latch on the LCC locks it into place to ensure proper connection to the midplane. You can add or replace an LCC while the DPE is powered up.

Disk Modules

Each disk module (see figure below) consists of a Fibre Channel disk drive in a carrier assembly. You can add or remove a disk module while the DPE is powered up.

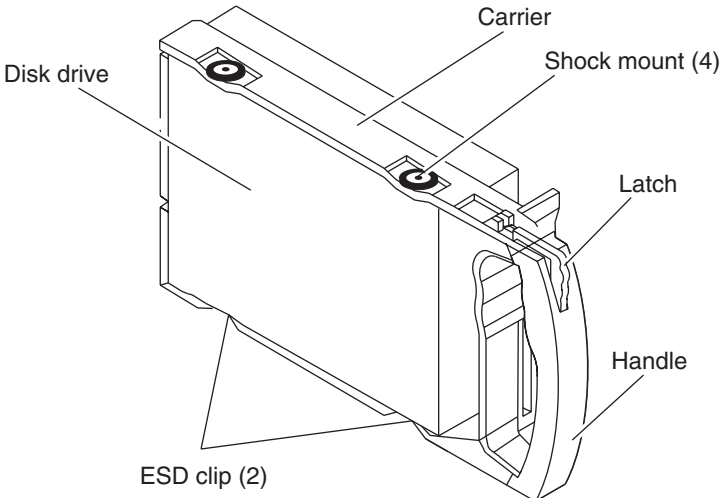


Figure 1-9 Disk Module

Disk Drives

The disk drives are 3.5-inch FC-AL drives that conform to the following standards:

- SFF-8067
- Fibre Channel Arbitrated Loop (FC-AL)
- FC-AL Private Loop Direct Attach (PLDA) profile

The disk module slots in the enclosure accommodate drives with heights of either 2.54 cm (1.0 inch) or 4.06 cm (1.6 inches). You can combine drives of either height, and from different manufacturers,

within the same DPE, subject to the restrictions imposed by the Core Software running in the DPE's SPs.

Drive Carrier

The disk-drive carrier is a plastic assembly that slides into the enclosure slot guides and midplane connectors. It has a handle with a latch and electrostatic discharge (ESD) clips, which connect to the drive's head-disk assembly. The latch holds the disk module in place to ensure proper connection with the midplane.

Power Supplies

The power supplies (see figure below) are located behind the drive fan pack. With two power supplies, the top supply is installed inverted with respect to the bottom supply.

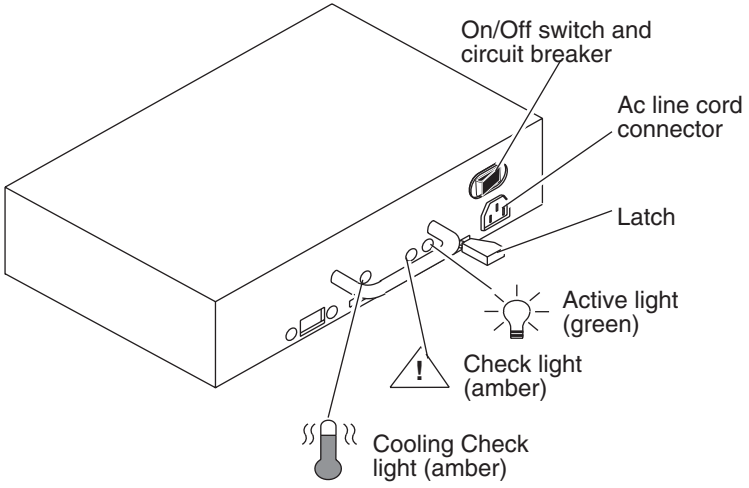


Figure 1-10 Power Supply

Each power supply is an auto-ranging, power-factor-corrected, multi-output, off-line converter with its own line cord and on/off switch. Each supply supports a fully configured DPE and shares load currents with the other supply, if it is present. The drive and LCC voltage lines have individual soft-start switches that protect the disk drives and LCCs if you install them while the DPE is powered up. A CRU with power-related faults will not adversely affect the operation of any other CRU.

Each power supply has status lights. These status lights are partially visible through the drive fan pack, and fully visible with the drive fan pack removed. The status lights are described in the "Monitoring DPE Status" section of Chapter 3.

A latch on the power supply locks it into place to ensure proper connection to the midplane. You can add or remove one power supply in a highly available DPE while the DPE is powered up.

Standby Power Supply (SPS)

Disk configurations that use write caching, such as RAID 5, require a standby power supply (SPS) to prevent data loss during a power failure. Data is maintained after a power loss.

One or two SPS units fit beneath the DPE and maintain power until write cache data can be safely stored to the disk. Installing an SPS and cabling it to the DPE are explained in the manual *DC Standby Power Supply (SPS) Installation* (014002887).

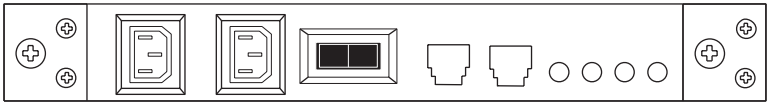


Figure 1-11 SPS

Drive Fan Pack

The drive fan pack (see Figure 1-11) cools the disk modules, power supplies, and LCCs in the DPE. A separate pack, described next, cools the SPs. The drive fan pack contains three fans that draw ambient room air through the front door, across the drive modules, and through the midplane and power supplies. The drive fan pack connects directly to both power supplies, and either supply can power it. The fans operate at a lower voltage and speed during normal operation to minimize acoustic noise. If a fan fails, the voltage and speed of the remaining fans increase to compensate, resulting in higher acoustic noise.

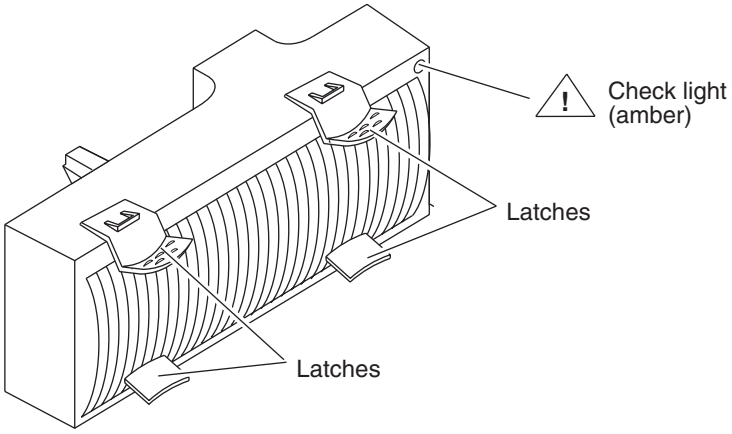


Figure 1-12 Drive Fan Pack

The drive fan pack has one status light. The status light is described in the "Monitoring DPE Status" section of Chapter 3.

Latches on the drive fan pack hold the pack in place.

You can remove the drive fan pack while the DPE is powered up. While the pack is removed, the cooling check light on each power supply flashes. If the pack is removed for more than approximately two minutes, the disk modules and SPs power down. The disk modules and SPs power up when you reinstall the drive fan pack.

SP Fan Pack

The SP fan pack (see Figure 1-12) cools the SPs. It contains three fans that draw ambient room air through the SP fan pack cover, through the midplane, and across the SPs. The SP fan pack connects to the DPE midplane via an internal cable, and either supply can power it. The fans operate at a lower voltage and speed during normal operation to minimize acoustic noise. If a fan fails, the voltage and speed of the remaining fans increase to compensate, resulting in higher acoustic noise.

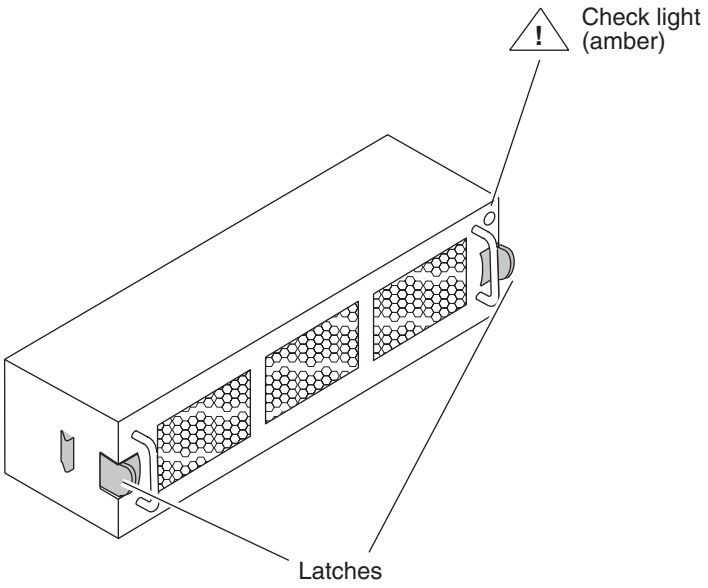


Figure 1-13 SP Fan Pack

Latches on the SP fan pack hold the pack in place.

The SP fan pack has one status light visible when the SP fan pack cover is removed. The status light is described in the "Monitoring DPE Status" section of Chapter 3.

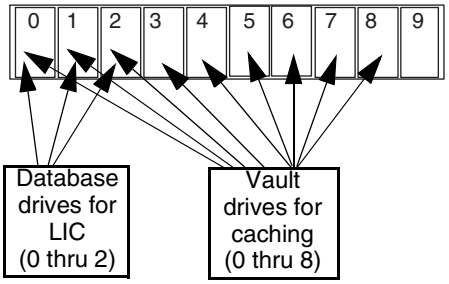
You can remove the SP fan pack while the DPE is powered up. If the pack is removed for more than approximately two minutes, the SPs and disk modules power down. The SPs and disk modules power up when you reinstall the SP fan pack.

Redundancy in Configurations

Mirrored storage-system write caching requires:

- Two SPs with equal memory of at least 128 Mbytes
- Two power supplies
- Two LCCs in the DPE and each DAE
- Disks in slots 0:0 through 0:8
- SPS (standby power supply) with a fully charged battery

DPE Rackmount



The following table describes the DPE's high-availability configurations.

Configuration	SPs	LCCs	Power supplies	Disk modules	SPSs
Maximum - HA	2	2	2	3 or more	0 (no write caching)
	2	2	2	9 or more	2 (high-availability write caching)

These configurations provide more redundancy, and therefore a higher degree of system availability. The drive fan packs and SP fan pack provide redundant cooling for all the configurations listed above.

What Next?

Continue to the next chapter, which explains how to install a DPE.

2

Installing a Rackmount DPE

This chapter describes the DPE installation requirements and procedures. Topics in this chapter include:

- Requirements 2-1
- Installing a DPE in a Cabinet 2-3
- DPE Powerup and Initialization 2-16
- DPE Powerdown 2-16
- Binding Disk Modules into Groups 2-18

Requirements

This section explains site, cabling, and addressing requirements.

Site Requirements

For proper DPE operation, the installation site must conform to certain environmental specifications. These are detailed below and in Appendix A.

Power

To determine a DPE's power requirements, use the power rating on the enclosure label. This rating is the maximum power required for a fully loaded enclosure. The input current, power (VA), and dissipation for the DPE are based on the maximum capability of the power supplies and cooling system to provide internally regulated power. Typical values will be less, depending on the number and manufacturer of disk drives. These values represent either the values for the power cord of a DPE with a single power supply, or the total values shared by the line cords of two power supplies in the same DPE, with the division between the power cords and supplies at the current sharing ratio. If one of the two power supplies fails, the

remaining supply and cord support the full load. You must use a rackmount cabinet with ac power distribution, and have main branch ac distribution that can handle these values for the number of DPEs and DAEs that you will interconnect.

Cooling

The ambient temperature specification is measured at the front door inlet. The site must have air conditioning of the correct size and placement to maintain the specified ambient temperature range. The air conditioning must be able to handle the BTU requirements of the DPEs and any connected DAEs.

Cabling Requirements

Use optical cables for connections to the external Fibre Channel environment. Use a copper cable only (not an optical cable) to connect a DPE to a DAE. The optical cables connect to the optical GBIC on the SP.

DPE and DAE interconnections should maintain LCC consistency. That is, one FC loop should connect the DPE's SP A (which connects internally to LCC A) and each DAE's LCC A. The other FC loop should connect the DPE's SP B (which connects internally to LCC B) and each DAE's LCC B.

Do not leave an unused (that is, dangling) cable connected to any Fibre Channel port because it may cause excess noise on the Fibre Channel.

Addressing Requirements

The addressing requirements vary depending on the environment, fibre port (fabric), or the fibre loop (FC-AL).

Fabric Environments

In a fabric environment, the DPE is addressed using the Source_ID (SID) and the Enclosure Address (EA).

Source_ID

The Source_ID (SID) is a value that a switch in the external Fibre Channel environment automatically assigns.

Enclosure Address (EA)

Each DPE and DAE on a back-end loop needs a unique enclosure address (EA) that identifies the enclosure and determines disk module addresses. The DPE has a fixed EA of 0 that you cannot change. If you cable any DAEs to the DPE, you might want to set the nearest DAE's EA to 1, the next to 2, and so on. The enclosure address is displayed in lights visible behind the front door.

Loop Environments

In an FC-AL environment, the DPE is addressed using the FC-AL address ID and the enclosure address (EA).

Fibre Channel Arbitrated Loop Address ID (FC-AL Address ID)

Each node (such as an SP) on the Fibre Channel front-end loop must have a unique Fibre Channel arbitrated loop address ID (FC-AL address ID). The FC-AL protocol translates the FC-AL address ID into an 8-bit arbitrated loop physical address (ALPA). You set the SP FC-AL address ID using switches, as explained later in this chapter.

Enclosure Address (EA)

Each DPE and DAE on a back-end loop needs a unique enclosure address (EA) that identifies the enclosure and determines disk module addresses. The DPE has a fixed EA of 0 that you cannot change. If you cable any DAEs to the DPE, you might want to set the nearest DAE's EA to 1, the next to 2, and so on. The enclosure address is displayed in lights visible behind the front door.

Installing a DPE in a Cabinet

The cabinet in which you will install the DPE(s) must have a full earth ground to provide reliable grounding. Also, the cabinet should have its own switchable power distribution. If any DPE you will install has two power supplies, we suggest that you use a cabinet that has dual power distribution units, one on each side.

WARNING

The rackmount DPE is heavy and should be installed into a rack by two people. To avoid personal injury and/or damage to the equipment, do not attempt to lift and install the DPE into a rack without help from another person.

WARNING

WARNUNG: Das Rackmount-DPE ist schwer und sollte nur von zwei Personen in einem Gehäuse installiert werden. Zur Vermeidung von körperlichen Verletzungen und/oder der Beschädigung des Gerätes, bitte die DPE nicht ohne die Hilfe einer zweiten Person anheben und einbauen.

We recommend that you use cabinet anti-tip devices, especially if you are installing or removing a DPE in the upper half of the cabinet when the lower half is empty.

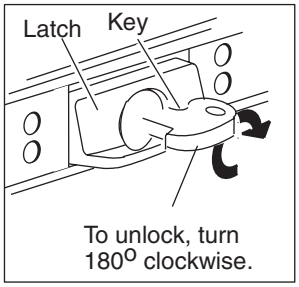
You install each DPE on two L-shaped mounting rails connected to the cabinet's vertical channels.

- Installing the cabinet itself is explained in another manual. For some standard cabinets, the information is in a cabinet installation manual shipped with the cabinet.
- Installing the mounting rails in the cabinet is explained in a rails installation manual shipped with the rails.

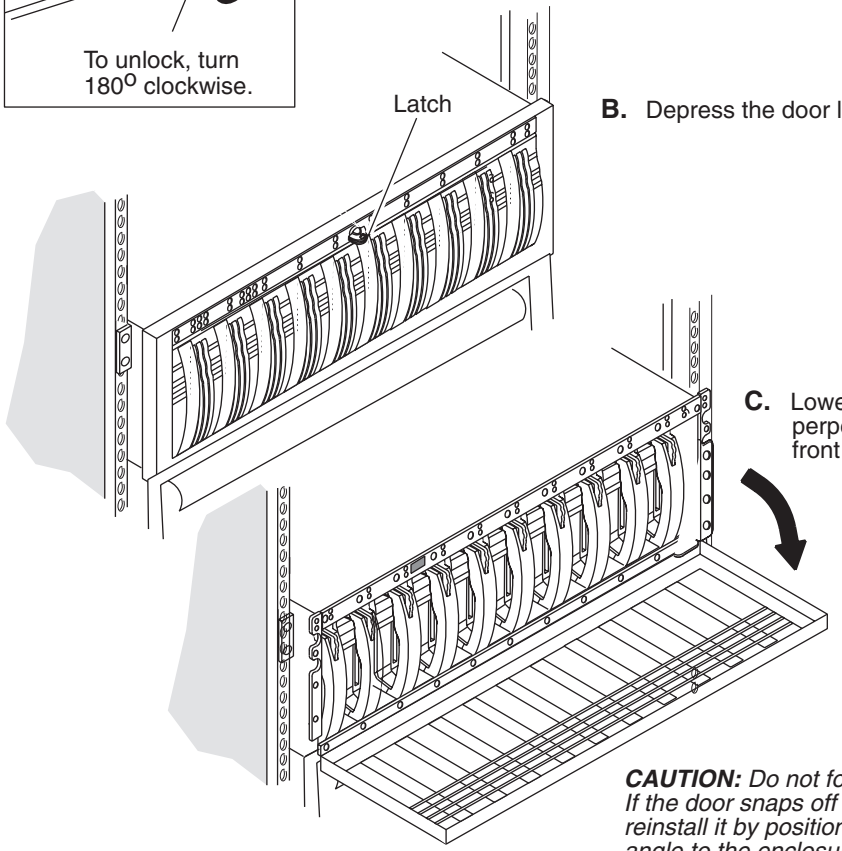
Installing DPEs on the Mounting Rails in the Cabinet

1. In the cabinet, set the main circuit breaker switches to the off position.
2. Attach the clip of the ESD wristband (strap) to bare metal on the cabinet, and put the wristband around your wrist with the metal button against your skin.
3. With help, lift the DPE and, from the front of the cabinet, slide the DPE onto the lowest rails.

4. Open the DPE front door as shown below.



A. If the door is locked:
Insert the key in the door's latch.
Turn the key 180° clockwise.
Remove the key from the latch, if desired. (If you do not remove the key, it may fall to the floor after you open the door.)



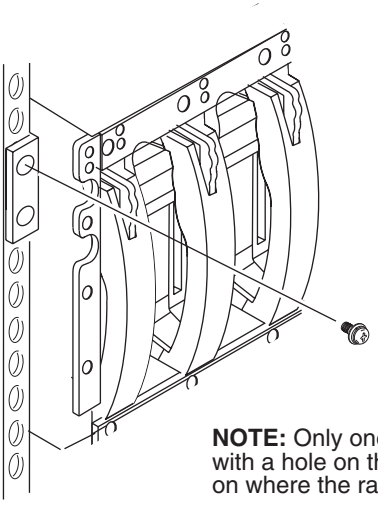
B. Depress the door latch.

C. Lower the door until it is perpendicular to the front of the enclosure.

CAUTION: *Do not force the door open. If the door snaps off its hinges, reinstall it by positioning it at a 45° angle to the enclosure, and snapping it into the hinge openings.*

Figure 2-1 Opening the Front Door

5. Secure the DPE to the vertical channels of the cabinet as shown next.



Fasten the front of the enclosure to the front channels in the cabinet using two screws (one per side).

NOTE: Only one hole in the enclosure bracket aligns with a hole on the channel. The hole you use depends on where the rails are mounted in the cabinet.

Figure 2-2 Securing the DPE to the Cabinet Front Channel

6. Secure the rear mounts of the DPE to the back channels of the cabinet, as shown in Figure 2-3.

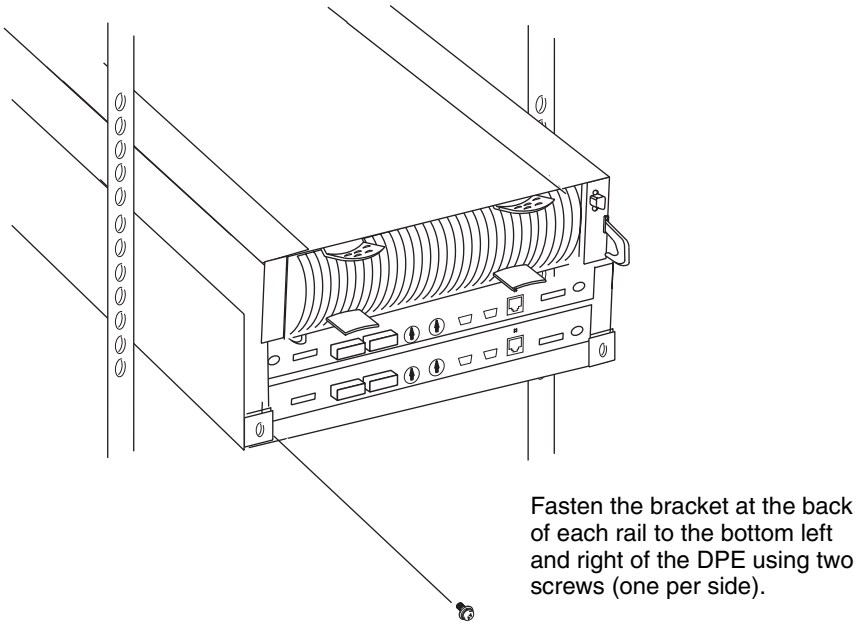


Figure 2-3 Securing the DPE to the Cabinet Back Channel

7. Close the DPE front door, as shown in Figure 2-4.

The door must be closed for EMI compliance. Open the door only to service the DPE.

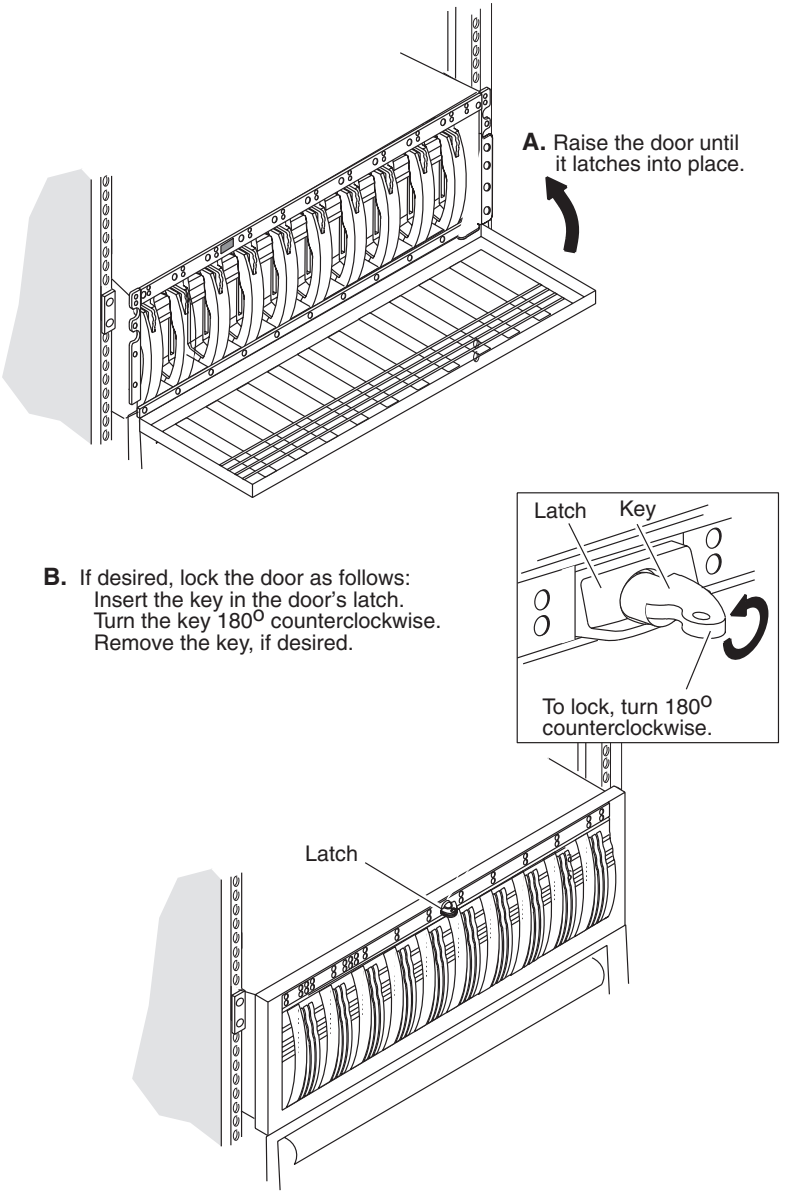

A. Raise the door until it latches into place.
B. If desired, lock the door as follows:
Insert the key in the door's latch.
Turn the key 180° counterclockwise.
Remove the key, if desired.
Latch
Key
To lock, turn 180° counterclockwise.
Latch

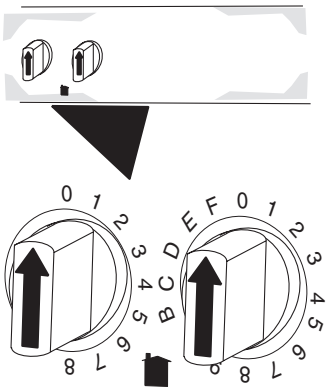
Figure 2-4 Closing and Locking the Front Door

8. Perform this step only if you are installing the DPE into an FC-AL environment. Otherwise, continue to the next step.

   To communicate in an FC-AL environment, each SP requires a unique FC-AL address ID (the front-end address). The FC-AL protocol translates the address ID into an 8-bit arbitrated loop physical address (ALPA). Valid Fibre Channel address IDs range from 0 through 125 (decimal) (0 through 7D hexidecimal).

   Each SP's Fibre Channel address ID must be unique on the Fibre Channel loop.

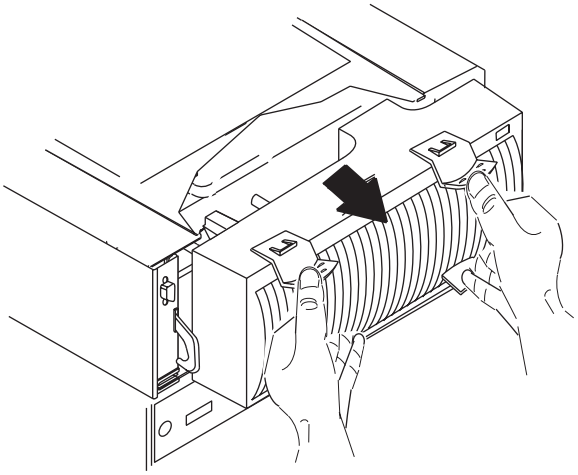
   At the back of the DPE, for each SP use the SP FC-AL ID switches (see Figure 2-5) to set the address ID.



FC-AL address ID (decimal)	Left switch setting	Right switch setting
0	0	0
1	0	1
. . .	. . .	. . .
15	0	F
16	1	0
. . .	. . .	. . .
31	1	F
32	2	0
. . .	. . .	. . .
125	7	D

Figure 2-5 SP Fibre Channel Arbitrated Loop Address ID Switches (Back of SP)

9. For access to the ac power inlets, you must remove the drive fan pack. Remove the drive fan pack as shown below.



A. Grasp the latches on the drive fan pack.

B. Squeeze the latches together and pull the pack from the enclosure.

Figure 2-6 Removing the Drive Fan Pack

10. From the back of the cabinet, plug the ac line cord into each power supply and turn on the supply's power, as shown in Figure 2-7.

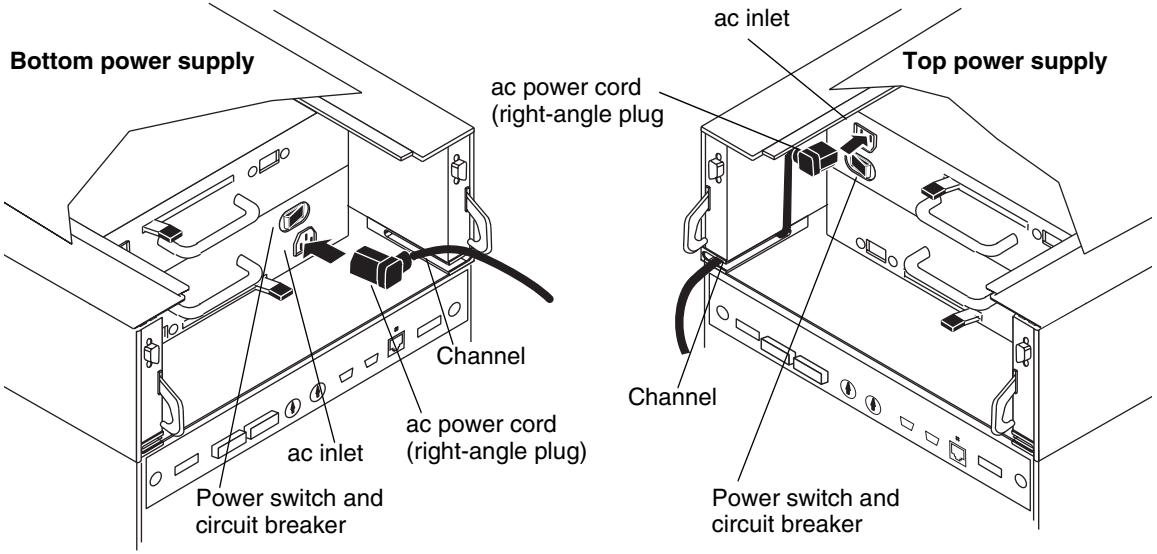


Figure 2-7 Plugging the AC Line Cord into the Power Supply and Turning on the Power Switch

11. Reinstall the drive fan pack on the back of the DPE.

    You can install the drive fan pack in either horizontal position. However, for a consistent image with DAEs, we recommend you install it with the check light in the upper right corner, as shown below.

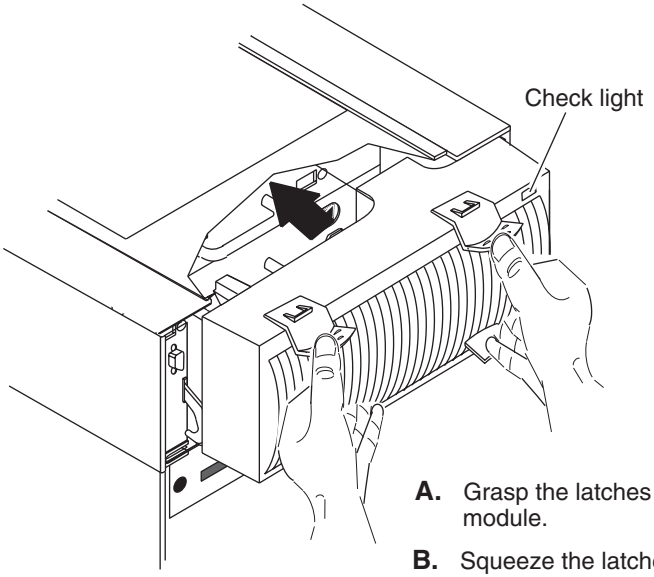

Check light
A. Grasp the latches on the drive fan module.
B. Squeeze the latches together and gently push the module into the enclosure until it clicks into place.

Figure 2-8 Installing the Drive Fan Module

12. Attach the Fibre Channel cable from SP A and/or B Port to the external environment) as shown next.

    When working with optical cables, observe the following precautions:

    - Keep the covers on all optical cables and optical GBICs until you are ready to insert the cables. The covers protect the cables and connectors, and prevent foreign particles, such as dust, from entering and affecting the connection.
    - Do not leave an unused (that is, dangling) cable, connected to an SP port because it may cause excess noise on the loop.

- Avoid tight bends. If you need to make a 90º bend, do it over 6 to 12 inches.
- Do not use optical cables to support weight. That includes long cable runs without support.
- Do not pull long runs of cable. It is best to lay the cable in place or pull only a few feet at a time.
- Run the cables so that they are not stepped on or rolled over by anything.

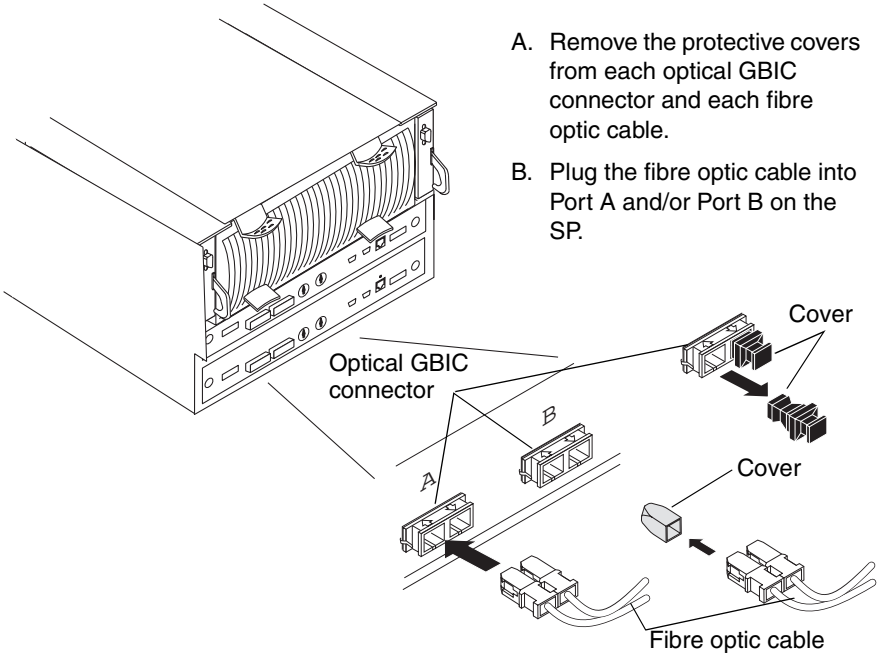
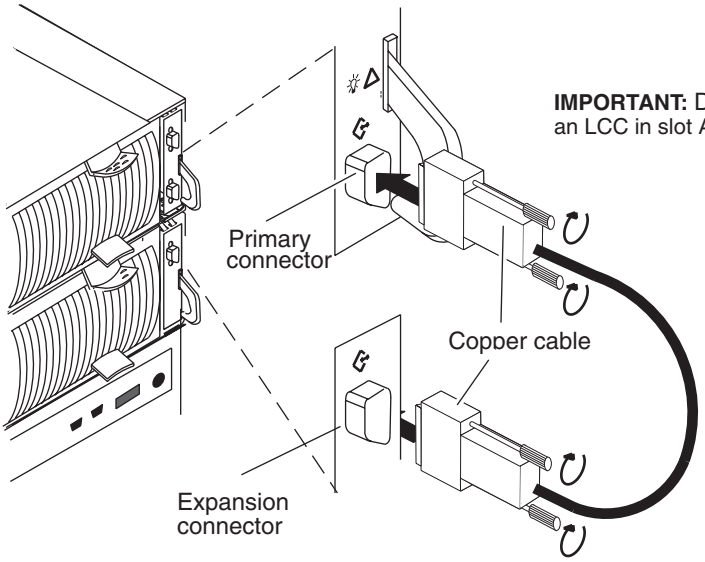

A. Remove the protective covers from each optical GBIC connector and each fibre optic cable.
B. Plug the fibre optic cable into Port A and/or Port B on the SP.
Cover
Optical GBIC connector
B
A
Cover
Fibre optic cable

Figure 2-9 Attaching Optical Cables to a DPE

13. To expand this DPE, cable its LCC EXP connector to the next corresponding DAE's PRI (primary) connector, as shown below.



IMPORTANT: Do not connect a cable between an LCC in slot A and an LCC in slot B.

A. Plug one end of a copper cable into the expansion (EXP) connector on an LCC in the DPE.

B. Tighten the two thumb screws on the cable's connector.

C. Plug the other end of the copper cable into the primary (PRI) connector on the matching LCC in the DAE.

D. Tighten the two screws on the cable's connector.

Figure 2-10 Cabling a DPE to a DAE

14. If the DPE has another SP, LCC, and DAE, connect the DPE's other LCC and the DAE's other LCC as above.
15. To connect additional DAEs, attach a copper cable between the DAE's LCC EXP connector and the next DAE's PRI (primary) connector (detailed in the *DAE Installation Manual*). If this DAE and the next DAE have a second LCC, repeat this step for the second LCC.
16. Make sure all the slots in the DPE and in each DAE contain either CRUs or filler modules. At least two disk modules are required in the DPE. We recommend inserting them in slots 0 and 1.
17. In the cabinet, set the main circuit breaker switches to the on position.

    The DPE and any DAEs in the cabinet will power up.

DPE Powerup and Initialization

The only power switches on a DPE are those on the power supply, which are normally covered by the drive fan pack. As a result, a DPE is always active.

When ac power is initially applied to a DPE, the disk drives power up and spin up in a specified sequence. The maximum delay is 48 seconds for the last drive to start spinning in a DPE, and 84 seconds for the last drive to start spinning in a DAE. The same delays occur when you insert a drive while a DPE is powered up.

DPE Powerdown

If DPE (with an SPS option) is powered down abnormally (e.g., a brown out or ac failure), data is saved to the storage-system vault disks, and not lost. However, when the DPE is powered back up again, it may take longer to come online.

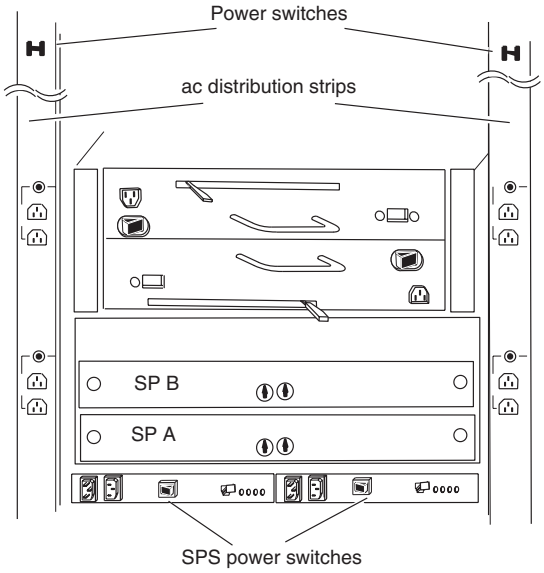
Turning Off the Power

1. Stop all I/O activity to the DPE.

   Stopping the I/O allows the SP to destage cache data, and may take some time. The length of time will be based on criteria such as the amount of cache, the amount of data in the cache, the type of data in the cache, and the target location on the disks.

2. If the server connected to the DPE is running the UNIX® operating system, unmount the file systems.
3. Shut off power to the ac distribution strips that supply the DPE.

   The power in the distribution strips may be controlled by a circuit breaker located inside the cabinet (if the cabinet has such breakers) or externally to the cabinet.



4. If the DPE has SPS protection, use the power switch on each SPS to turn off power.

   When you turn off power to a storage system with an SPS, the On Battery light may come on for a maximum of 90 seconds during which time the DPE will continue to run. This is a normal condition. Wait for the light to go off and the fans to stop before proceeding with further service to the storage system.

Never remove the fan pack and then shut off the power supply to shut down an DPE. Doing that effectively cuts out the SPS and write cache data cannot be saved to the vault drives, which results in a cache dirty condition (data loss). When that happens, LUNs become inaccessible and the unsolicited event log displays a message similar to: "`Enclosure 0 Disk 5 0x90a (Can't Assign - Cache Dirty) 0 0xafb40 0x14362c.`" Navisphere Manager or Supervisor will show that the inaccessible LUNs are unowned. Contact your service provider if this situation occurs. The LUNs may need to be unbound and rebound.

Powering On

Reverse the steps in the previous section to power up the DPE.

Binding Disk Modules into Groups

After cabling a DPE and any DAEs, you can bind disk modules into groups and set up storage-system caching. To bind disk modules and set up caching, you will use a utility described in the server setup or installation manual.

3

Servicing and Upgrading a DPE

This chapter describes how to monitor DPE status, handle CRUs, and replace or add a CRU. Topics in this chapter include:

- Monitoring DPE Status 3-1
- Handling CRUs 3-4
- Power Issues and CRUs 3-4
- Avoiding Electrostatic Discharge (ESD) Damage 3-6
- Precautions When Removing, Installing, or Storing CRUs 3-7
- Precautions When Handling Optical Cables 3-8
- Replacing or Adding a Disk Module 3-9
- Replacing the SP Fan Pack 3-14
- Replacing an Optical GBIC 3-17
- Removing an SP or an SP Filler Module 3-21
- Installing or Replacing an SP Memory Module 3-24
- Installing an SP or SP Filler Module 3-26
- Replacing or Adding an LCC Module 3-30
- Replacing the Drive Fan Pack 3-34
- Replacing or Adding a Power-Supply Module 3-36

Monitoring DPE Status

Status lights on the DPE and its CRUs indicate error conditions. These lights are visible outside the DPE. Some lights are visible from the front, and the others from the back. The following figure and table describes the status lights.

The Check status light for the SP fan pack is not visible with the fan pack cover in place. If the DPE system Check light is on with no other Check light on, remove the fan pack cover, as shown on page 3-14, to examine the SP fan pack Check status light.

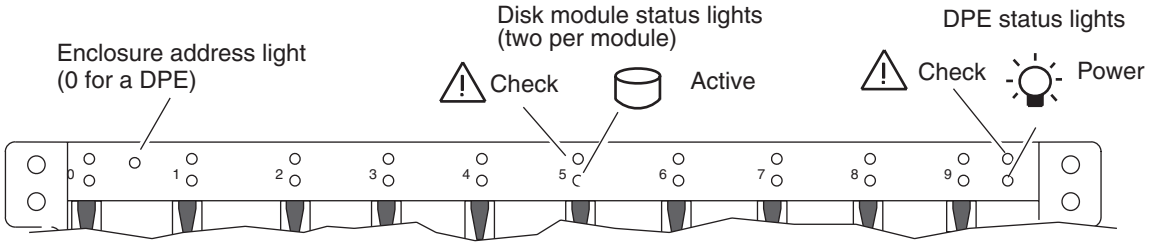


Figure 3-1 Status Lights Visible from the Front of the DPE

Table 3-1 Status Lights Color Codes, Front of DPE

Light	Quantity	Color	Meaning
Enclosure Address	1	Green	On to indicate enclosure address zero.
DPE Check	1	Amber	On when any fault condition exists; if the fault is not obvious from another fault light on the front, look at the back of the DPE.
SP Fan Pack Check	1	Amber	On when the SP fan pack is faulty (not visible with fan pack cover on; to remove cover, see page 3-14).

Table 3-1 Status Lights Color Codes, Front of DPE (*continued*)

Light	Quantity	Color	Meaning
Disk Active	1 per disk module slot	Green	Off when the module slot is empty or contains a filler module. Flashing *(mostly off)* when the drive is powered up but not spinning; this is a normal part of the spin-up sequence, occurring during the spin-up delay of a slot. Flashing *(at a constant rate)* when the disk drive is spinning up or spinning down normally. On when the drive is spinning but not handling any I/O activity (the ready state). Flashing *(mostly on)* when the disk drive is spinning and handling I/O activity.
Disk Check	1 per disk module slot	Amber	On when the disk module is faulty or as an indication to remove the disk module.
DPE Active	1	Green	On when the DPE is powered up.
DPE Check	1	Amber	On when any fault condition exists; if the fault is not obvious from another fault light on the front, look at the back of the DPE.
SP Fan Pack Check	1	Amber	On when the SP fan pack is faulty (not visible with fan pack cover on; to remove cover, see page 3-14).

Table 3-2 Status Lights Color Codes, Back of DPE

Light	Quantity	Color	Meaning
SP Active	1 per SP	Green	On when the SP is operating normally or flashing when firmware is being loaded.
SP Check	1 per SP	Amber	On when an SP fault condition exists.
LAN Link/Activity	1 per SP	Green	On when there is a valid Ethernet connection; blinks during Ethernet activity.
LAN Speed	1 per SP	Amber	On when the Ethernet connection is a 100Base-TX connection.
LCC Active	1 per LCC	Green	On when the LCC is powered up.
LCC Check	1 per LCC	Amber	On when either the LCC or a FC-AL connection is faulty.
Power Supply Active	1 per supply	Green	On when the power supply is operating.

Table 3-2 Status Lights Color Codes, Back of DPE (*continued*)

Light	Quantity	Color	Meaning
Power Supply Check	1 per supply	Amber	On when the power supply is faulty or is not receiving ac line voltage.
Cooling Check	1 per supply	Amber	Flashing when multiple fans in the drive fan pack are faulty or the drive fan pack is removed. The DPE powers down the SPs and disk drives when the fault persists for more than about two minutes.
Drive Fan Pack Check	1 on fan pack	Yellow	On when a fan in the drive fan pack is faulty.

- If the DPE Check light is on, you should look at the other Check lights to determine which CRU(s) are faulty. If the Check light for a CRU remains on, replace the CRU as soon as possible.
- If a CRU fails in a DPE that is highly available, the DPE's high availability and write cache functionality (if any) will be compromised until you replace the faulty CRU.

Handling CRUs

This section describes the precautions that you must take, and the general procedures you must follow when removing, installing, and storing CRUs.

Power Issues and CRUs

The DPE is designed to be powered up at all times and hot repairable. Its front door should be closed and each of its compartments should contain a CRU or filler panel to ensure EMI compliance and proper air flow over the CRUs.

While the DPE is powered up, you can service or replace any CRU, although removing an active LCC or SP will affect operating system access to the LUNs it controls. Do not remove a faulty CRU until you have a replacement available.

You can remove the drive fan pack or SP fan pack while the DPE is powered up. If the pack is removed for more than two minutes, the SPs and disk modules power down. The SPs and disk modules power up when you reinstall the drive or SP fan pack.

Since you can replace or add any CRU without sliding the DPE out of the cabinet, you do *not* have to use cabinet anti-tip devices when you upgrade or service a DPE.

If you need to power down a DPE, either:

- Shut down the main ac lines to the DPE, or
- Remove the drive fan pack (described on page 3-35) and set the power switch on each power supply to the off (O) position.

Avoiding Electrostatic Discharge (ESD) Damage

When you replace or install CRUs, you can inadvertently damage the sensitive electronic circuits in the equipment by simply touching them. Electrostatic charge that has accumulated on your body discharges through the circuits. If the air in the work area is very dry, running a humidifier in the work area will help decrease the risk of ESD damage. You must follow the procedures below to prevent damage to the equipment.

Read and understand the following instructions.

- Provide enough room to work on the equipment. Clear the work site of any unnecessary materials or materials that naturally build up electrostatic charge, such as foam packaging, foam cups, cellophane wrappers, and similar items.
- Do not remove replacement or upgrade CRUs from their antistatic packaging until you are ready to install them.
- Gather together the ESD kit and all other materials you will need before you service a DPE. Once servicing begins, you should avoid moving away from the work site; otherwise, you may build up an electrostatic charge.
- Use the ESD kit when handling any CRU. If an emergency arises and the ESD kit is not available, follow the procedures in the "Emergency Procedures (Without an ESD Kit)" section.
- An ESD wristband (part no. 129002319) is supplied with your DPE. To use it, attach the clip of the ESD wristband (strap) to any bare (unpainted) metal on the DPE enclosure; then put the wristband around your wrist with the metal button against your skin.

Emergency Procedures (Without an ESD Kit)

In an *emergency* when an ESD kit is not available, use the following procedures to reduce the possibility of an electrostatic discharge by ensuring that your body and the subassembly are at the same electrostatic potential.

These procedures are not a substitute for the use of an ESD kit. Follow them only in the event of an emergency.

- Before touching any CRU, touch a bare (unpainted) metal surface of the enclosure.
- Before removing any CRU from its antistatic bag, place one hand firmly on a bare metal surface of the enclosure, and at the same time, pick up the CRU while it is still sealed in the antistatic bag. Once you have done this, *do not* move around the room or contact other furnishings, personnel, or surfaces until you have installed the CRU.
- When you remove a CRU from the antistatic bag, avoid touching any electronic components and circuits on it.
- If you must move around the room or touch other surfaces before installing a CRU, first place the CRU back in the antistatic bag. When you are ready again to install the CRU, repeat these procedures.

Precautions When Removing, Installing, or Storing CRUs

Use the precautions listed below when you remove, handle, or store CRUs.

- Do not remove a faulty CRU until you have a replacement available.
- Handle a CRU only when using an ESD wristband as follows: attach the clip of the ESD wristband to the ESD bracket or bare metal on the DPE enclosure, and put the wristband around your wrist with the metal button against your skin.
- Handle CRUs gently. A sudden jar, drop, or vibration can permanently damage a CRU.
- Never use excessive force to remove or install a CRU.
- Store a CRU in the antistatic bag and specially designed shipping container in which you received it. Use that container if you need to return the CRU for repair.
- Maintain the location where you store CRUs within the limits specified in Appendix A.

Precautions When Handling Optical Cables

When working with optical cables, observe the following precautions:

- Keep the covers on all optical cables and optical GBICs until you are ready to insert the cables. The covers protect the cables and connectors, and prevent foreign particles, such as dust, from entering and affecting the connection.
- Avoid tight bends. If you need to make a 90º bend, do it over 6 to 12 inches
- Do not use optical cables to support weight. That includes long cable runs without support.
- Do not pull long runs of cable. It is best to lay the cable in place or pull only a few feet at a time.
- Run the cables so that they are not stepped on or rolled over by anything.

Replacing or Adding a Disk Module

CAUTION

When replacing or adding a disk module, observe the following:

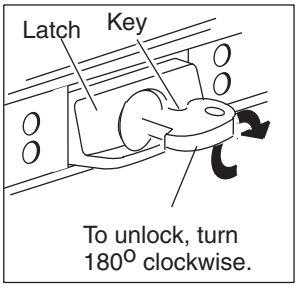
- **Remove or install disk modules only while the storage system is powered up.**
- **Do not move a disk module that is part of an existing LUN to another slot in the storage system. If you do, you risk destroying the storage system beyond recovery, or data loss at the very least. Each disk module has LUN-identifying information assigned to it when it is bound. Moving it to another slot can make the information stored on the disk module from the original LUN inaccessible. If you must move a disk module to another slot, unbind the LUN first; unbinding destroys all data on the LUN.**
- **A disk module must be inserted all the way or removed entirely. Do not leave a disk module partially removed except for periods when you are allowing it to spin down. A disk module being inserted or removed may be damaged by a partially removed adjacent module.**
- **Handle a disk module gently and use an ESD wristband. Do not remove a faulty disk module until you have a replacement module (with the same part number) or a filler module available. The part number (PN005xxxxxx) appears on the top or bottom of the module. A replacement disk module should have the same format (52- byte-per-sector format is required for arrays) and the same capacity (size and speed) as the disk it is replacing. An add-on can be any capacity but must be the 520-byte-per-sector format. LUNs should be created using disk modules of equal size and speed.**
- **When removing or installing multiple disk modules, wait for the activity lights on all other disk modules to resume a steady flicker before removing or installing the next disk module. The activity lights show that the Core Software has rediscovered the FC loop.**

If you want to use a *previously used* disk module as a spare, contact your service provider for assistance.

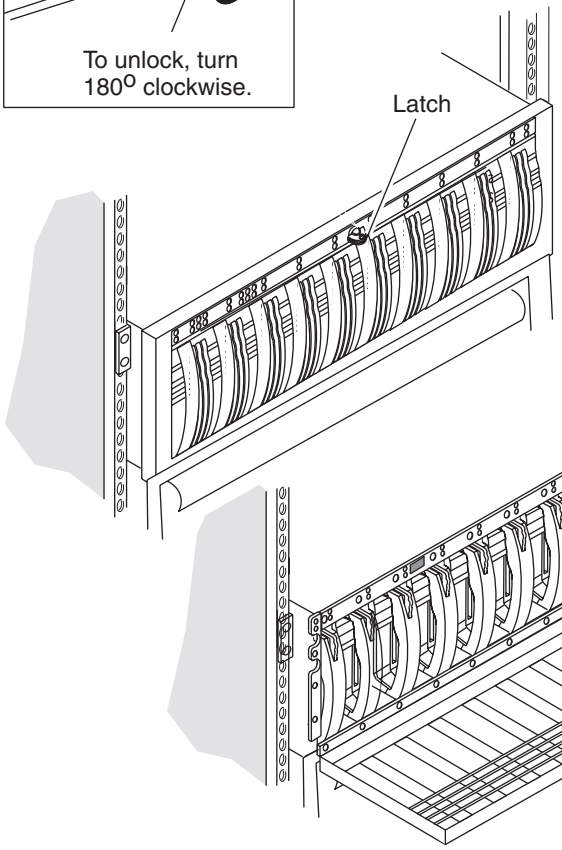
You must open the DPE's front door to access the disk modules. The door must be closed for EMI compliance when the DPE is powered up. Open it only to replace or add a disk module.

Removing a Disk or Disk Filler Module

1. Unlock and open the front door as shown below.



A. If the door is locked:
Insert the key in the door's latch.
Turn the key 180° clockwise.
Remove the key from the latch, if desired. (If you do not remove the key, it may fall to the floor after you open the door.)



B. Depress the door latch.

C. Lower the door until it is perpendicular to the front of the enclosure.

CAUTION: *Do not force the door open. If the door snaps off its hinges, reinstall it by positioning it at a 45° angle to the enclosure, and snapping it into the hinge openings.*

Figure 3-2 Unlocking and Opening the Front Door

2. Locate the slot where you want to install the new or replacement disk module.
3. Remove the disk or disk filler module from the slot as shown below.

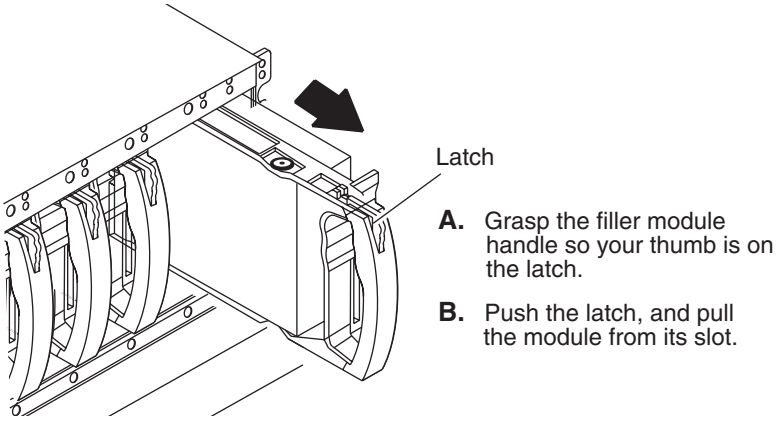


Figure 3-3 Removing a Disk Filler Module

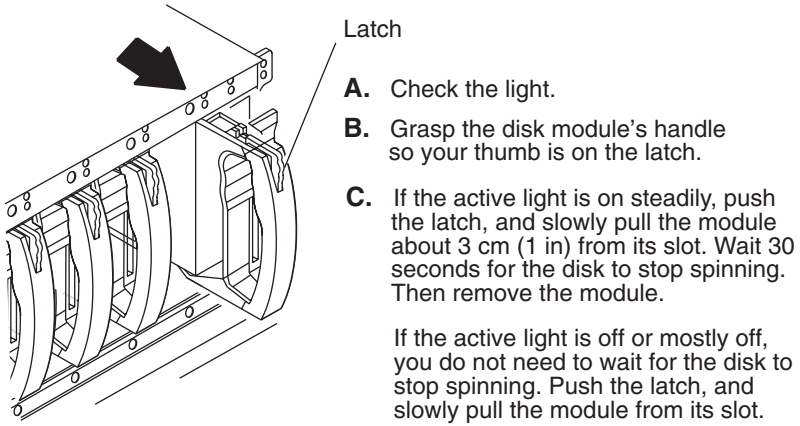

Latch
A. Check the light.
B. Grasp the disk module's handle so your thumb is on the latch.
C. If the active light is on steadily, push the latch, and slowly pull the module about 3 cm (1 in) from its slot. Wait 30 seconds for the disk to stop spinning. Then remove the module.
If the active light is off or mostly off, you do not need to wait for the disk to stop spinning. Push the latch, and slowly pull the module from its slot.

Figure 3-4 Removing a Disk Module

After removing a disk module, wait for the activity lights on the other disk modules to resume a steady flicker before removing another disk module. The activity lights show that the Core Software has rediscovered the FC loop.

Continue to the next section to install the new or replacement disk module.

Installing a Disk Module

1. Gently insert the module as follows:

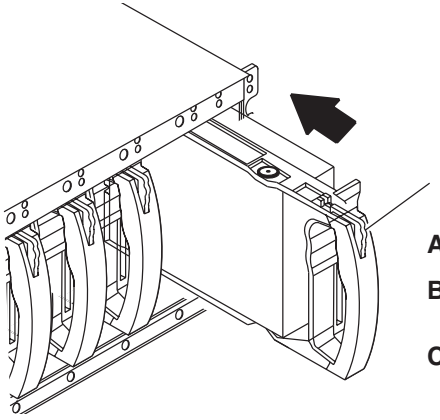

Latch
A. Grasp the disk module's handle.
B. Align the module with the guides in the slot.
C. Gently push the module into the slot until the latch engages.

Figure 3-5 Installing a Disk Module

The disk module Active light flashes to reflect the spin-up sequence (see page 3-2).

After inserting a disk module, wait for the activity lights on the other drives to resume a steady flicker before inserting another module. The activity lights show that the Core Software has rediscovered the FC loop.

---

2. Remove and store the ESD wristband.

The door must be closed for EMI compliance when the DPE is powered up. Open it only to replace or add a disk module.

---

3. Close and lock the front door as shown below.

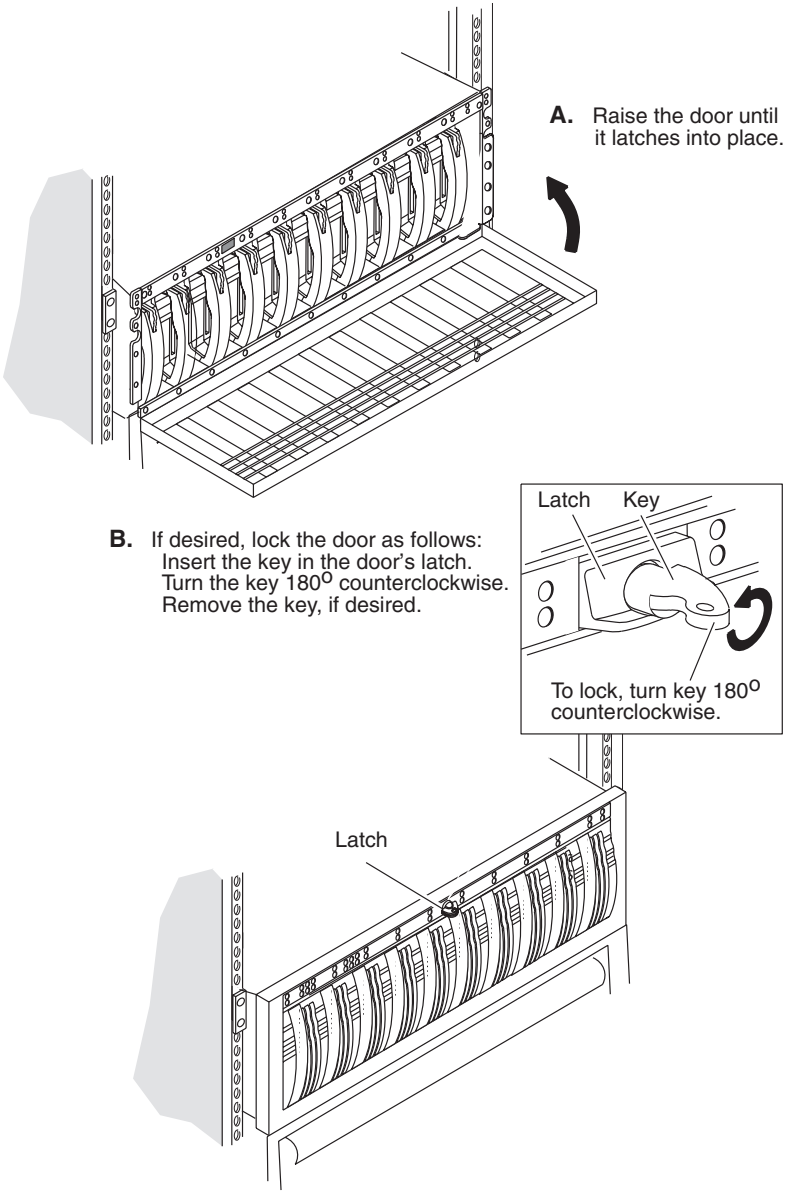

A. Raise the door until it latches into place.
B. If desired, lock the door as follows:
Insert the key in the door's latch.
Turn the key 180° counterclockwise.
Remove the key, if desired.
Latch
Key
To lock, turn key 180° counterclockwise.
Latch

Figure 3-6 Closing and Locking the Front Door

Replacing the SP Fan Pack

CAUTION

Handle a fan pack gently and use an ESD wristband. Do not remove a faulty fan pack until you have a replacement available. You can remove the fan pack while the DPE is powered up. If the pack is removed for more than about two minutes, the SPs and disk modules power down. The SPs and disk modules power up when you reinstall the SP fan pack.

Removing the SP Fan Pack

1. At the front of the DPE, grasp the SP fan pack cover at its sides and pull it from its ballstud mounts as shown below.

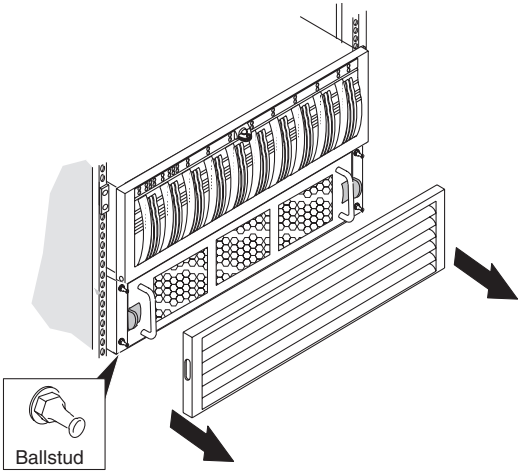
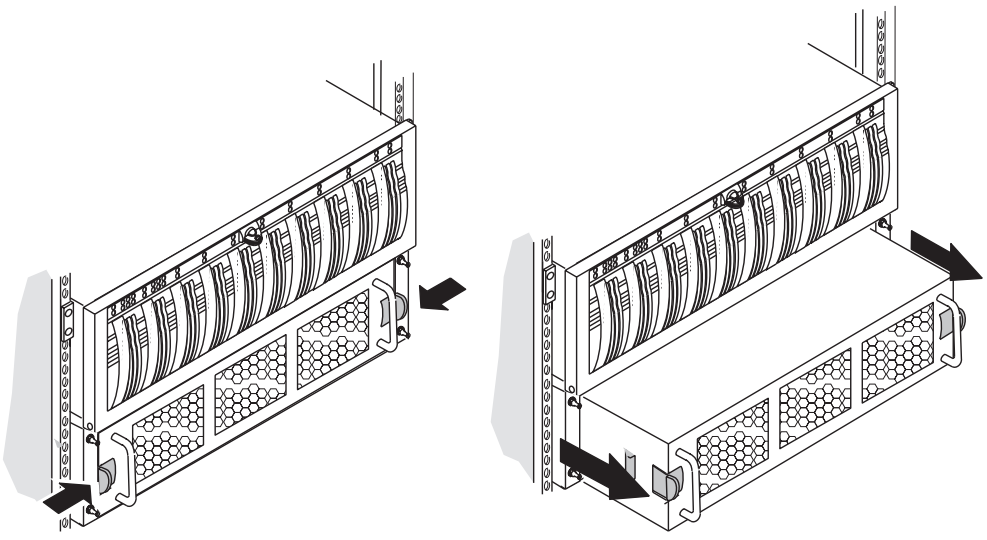


Figure 3-7 Removing the SP Fan Pack Cover

2. Remove the fan pack as shown next.



A. Slide the latches on the fan pack inward as shown, and hold them in.

B. Grasp the handles and gently pull the pack from the enclosure.

Figure 3-8 Removing the SP Fan Pack

Installing the SP Fan Pack

1. At the front of the DPE, insert the replacement fan pack into the enclosure, and push gently until the latches engage as shown next.

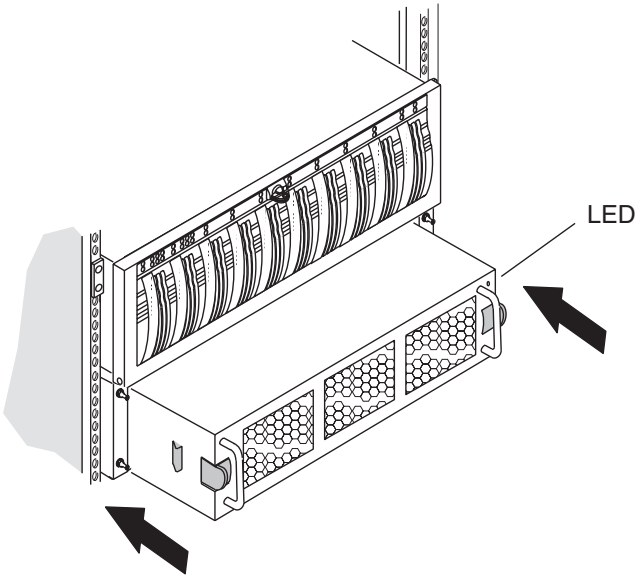


Figure 3-9 Installing the Replacement SP Fan Pack

2. At the front of the deskside DPE, grasp the SP fan pack cover at its sides and push it onto its ballstud mounts with the louvers slanted downward as shown next.

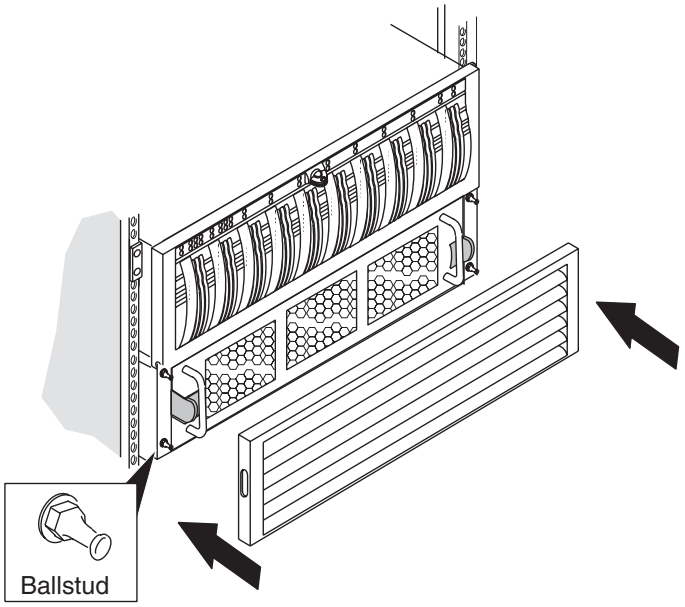


Figure 3-10 Installing the SP Fan Pack Cover

Replacing an Optical GBIC

CAUTION

Use an ESD wristband.

Removing an Optical GBIC Connector

Before removing any cables, make note of which cables are connected to which SP ports.

1. Remove any optical cables from the SP, as shown next.

   Place the original covers on all optical cables and optical GBIC connectors while they are disconnected. The covers protect the cables and connectors and prevent foreign particles, such as dust, from entering and affecting the connection.

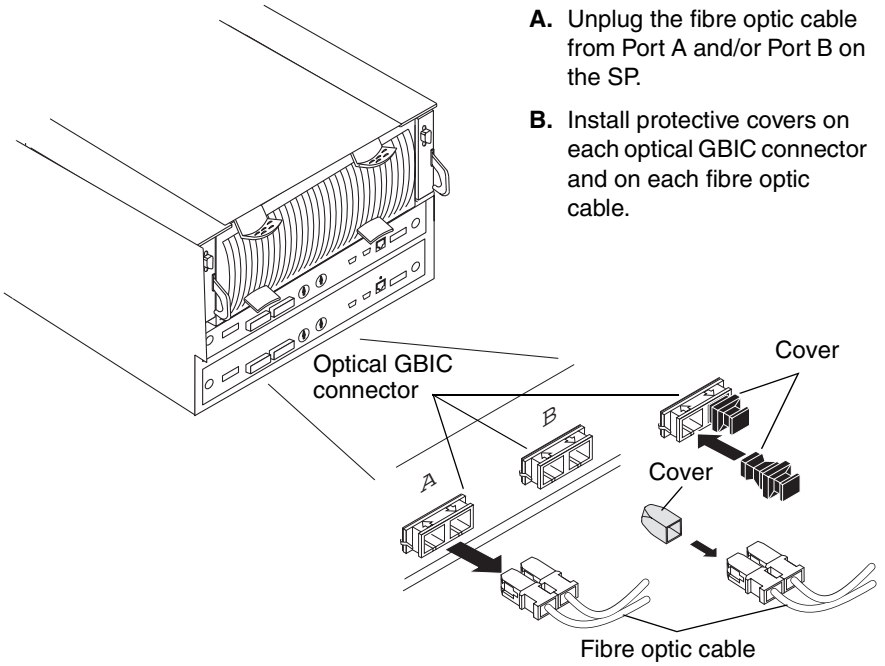

A. Unplug the fibre optic cable from Port A and/or Port B on the SP.
B. Install protective covers on each optical GBIC connector and on each fibre optic cable.
Optical GBIC connector
Cover
Cover
A
B
Fibre optic cable

Figure 3-11 Removing an Optical Cable from an SP

2. Remove the optical GBIC connector(s) from the SP as shown below.

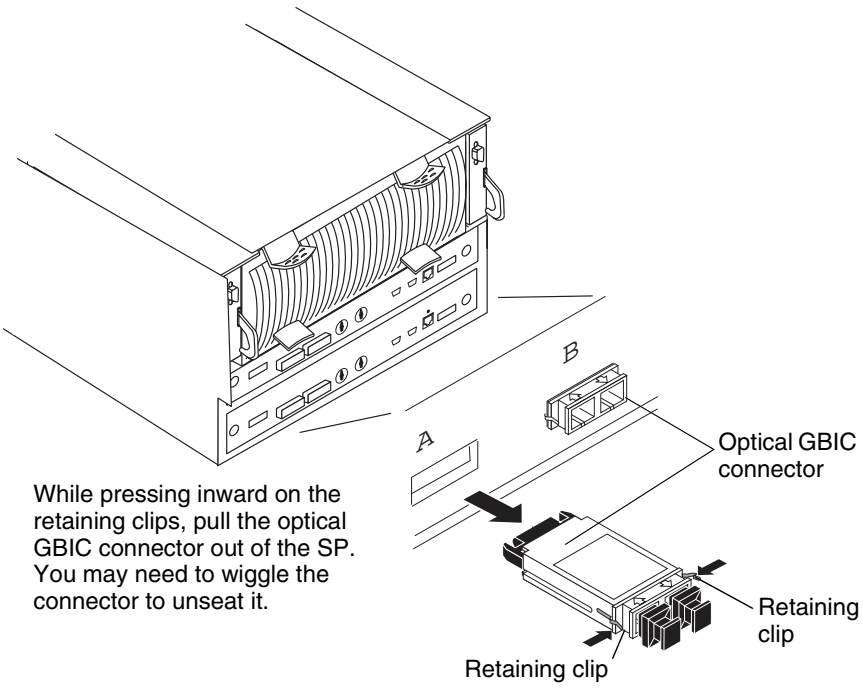

While pressing inward on the retaining clips, pull the optical GBIC connector out of the SP. You may need to wiggle the connector to unseat it.
A
B
Optical GBIC connector
Retaining clip
Retaining clip

Figure 3-12 Removing an Optical GBIC Connector from an SP

Installing an Optical GBIC Connector

1. Install the optical GBIC connector(s) on the SP as shown next.

A. Position the optical GBIC connector with the alignment slot toward the bottom.

B. Push the optical GBIC connector into SP Port A and/or Port B until it is firmly seated and the retaining clips are engaged.

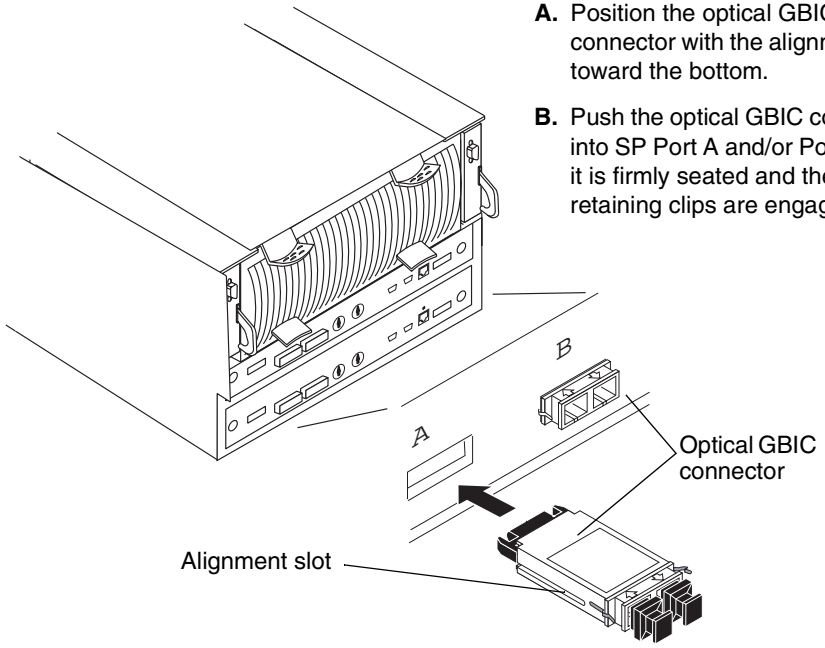


Figure 3-13 Installing an Optical GBIC Connector on an SP

2. Install the appropriate optical cable(s) on the SP's optical GBIC connector(s) as previously noted and as shown below.

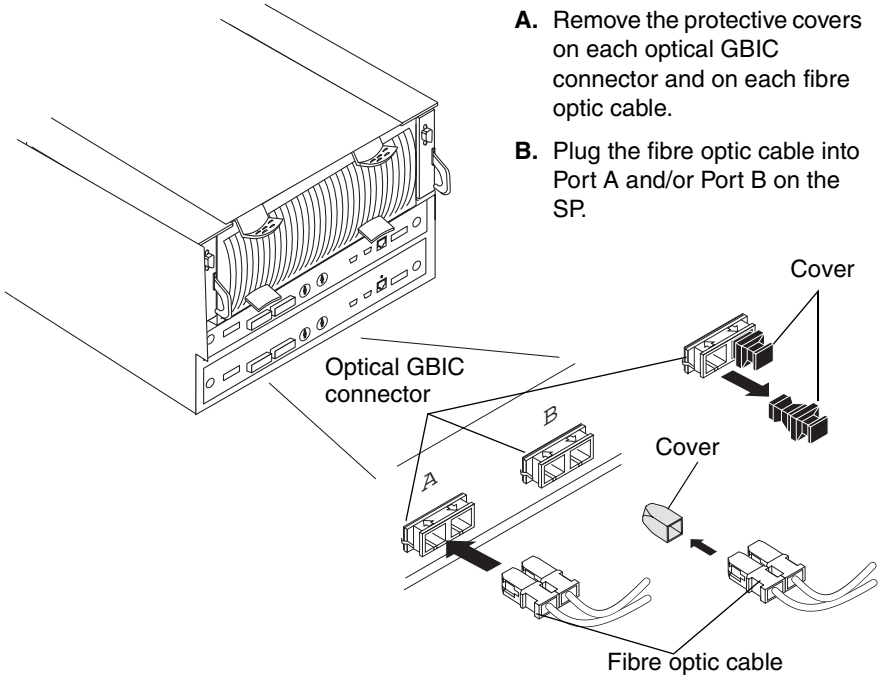

A. Remove the protective covers on each optical GBIC connector and on each fibre optic cable.
B. Plug the fibre optic cable into Port A and/or Port B on the SP.
Cover
Optical GBIC connector
B
A
Cover
Fibre optic cable

Figure 3-14 Installing an Optical Cable on an SP

3. Remove and store the ESD wristband.

Removing an SP or an SP Filler Module

CAUTION

Handle an SP gently and use an ESD wristband. Do not remove a faulty SP until you have a replacement module or filler module available.

SPs, GBICs, and memory modules are separate CRUs. New or replacement SPs are shipped without memory modules or GBICs. When a memory module and/or GBICs are ordered with the SP, they will arrive with the SP; however, they will not be installed on the SP

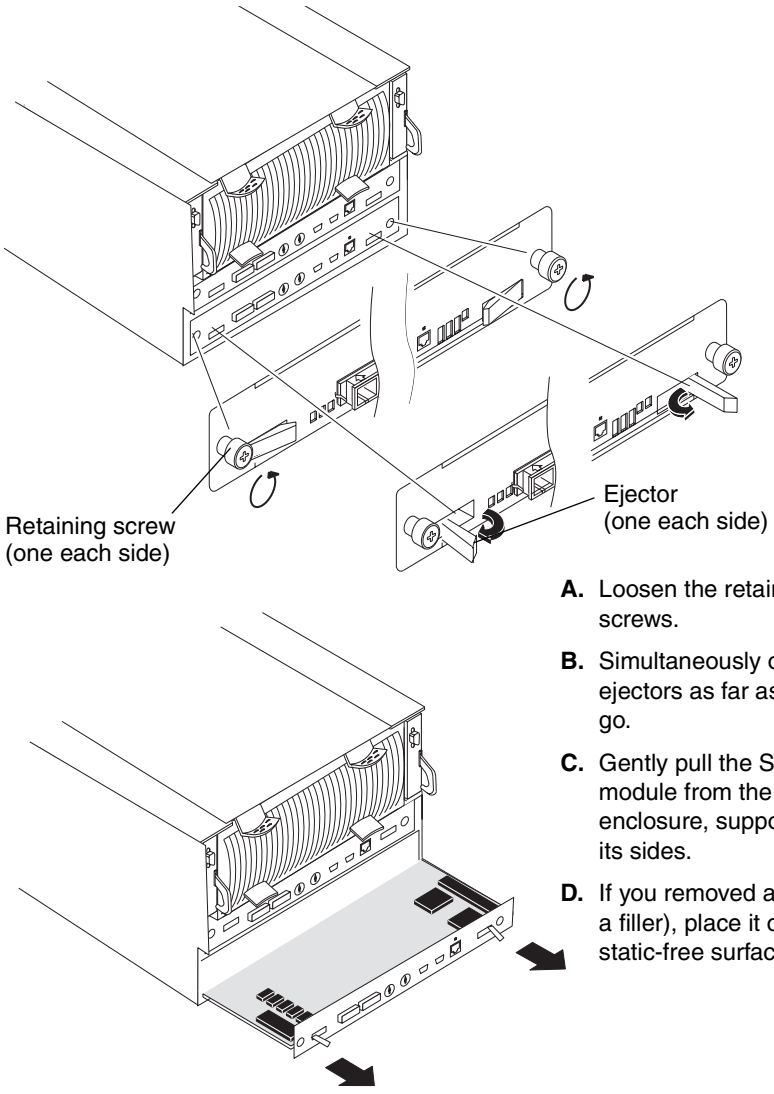
board. Before you install a new or replacement SP, you must install a memory module (a new one or one you removed from a returned SP and saved). When returning a faulty SP, you must remove the memory modules and optical GBICs before you return the faulty SP.

If you want to install an add-on SP, be sure to install the SP memory first as shown starting on page 3-25. To add memory to an installed SP, you must first remove the SP as follows.

Before removing an SP from a storage system that has caching enabled, you should disable the storage-system cache using a utility described in the server setup manual.

---

1. Perform the appropriate substep.
   a. If you are removing a filler module, continue to the next step.
   b. If you are replacing the SP, remove the cables and GBIC connectors from the SP (see page 3-17 or page 3-21).
   c. If you are removing the SP to replace the memory module, remove the cables (see page 3-18 or page 3-21).
2. Remove the SP or filler module from its slot as shown next:



A. Loosen the retaining screws.

B. Simultaneously open the ejectors as far as they will go.

C. Gently pull the SP or filler module from the enclosure, supporting it at its sides.

D. If you removed an SP (not a filler), place it on a static-free surface.

Figure 3-15 Removing an SP or Filler Module

Installing or Replacing an SP Memory Module

SPs, GBICs, and memory modules are separate CRUs. New or replacement SPs are shipped without memory modules or GBICs. When a memory module and/or GBICs are ordered with the SP, they will arrive with the SP; however, they will not be installed on the SP board. Before you install a new or replacement SP, you must install a memory module (a new one or one you removed from a returned SP and saved). You must remove the memory modules and GBICs before you return a faulty SP.

Before removing or installing an SP or SP memory module, observe the following:

- Read "Avoiding Electrostatic Discharge (ESD) damage" on page 3-6.
- Before removing or installing the SP or SP memory module, attach the clip of the ESD wristband to the ground on the SP or DPE enclosure; then put the wristband around your wrist with the metal button against your skin.

Removing an SP Memory Module

1. Remove the SP from the DPE (see page 3-23), and place it on a static-free work surface.
2. Remove the memory module (DIMM) from the SP as shown next.

A. Use your thumbs to push out on the locking tabs, and use your fingers to lift the DIMM upward until it releases from the tabs.

B. Lift the module out of the connector, and place it in its own antistatic packaging.

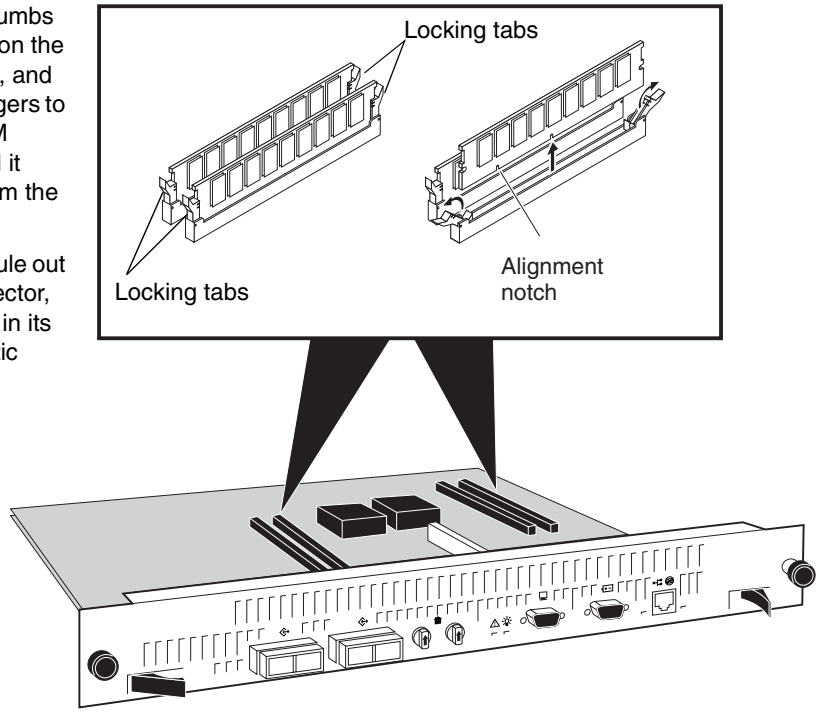


Figure 3-16 Removing the Memory Module from the SP

After removing the memory module, if you want to ship the SP, store it in its antistatic bag and special shipping package. Then remove and store the ESD wristband.

Installing an SP Memory Module

Depending on the memory size (in megabytes), the SP memory module can contain chips on only one side or on both sides.

1. Place the SP and the memory module (DIMM) on a static-free work surface.
2. On the SP, install the DIMM in the appropriate connector as shown next.

A memory module has a notch on its edge near pin 1 so that you can insert it only one way. Install memory modules one at a time, and in order, starting with connector 1 (refer to Figure 3-17).

A. Lift the module out of its antistatic packaging and place the module into the connector.

B. Ensure that the alignment notch is correctly oriented.

C. Use your fingers to push out on the locking tabs, and use your thumbs to push the module in until seated.

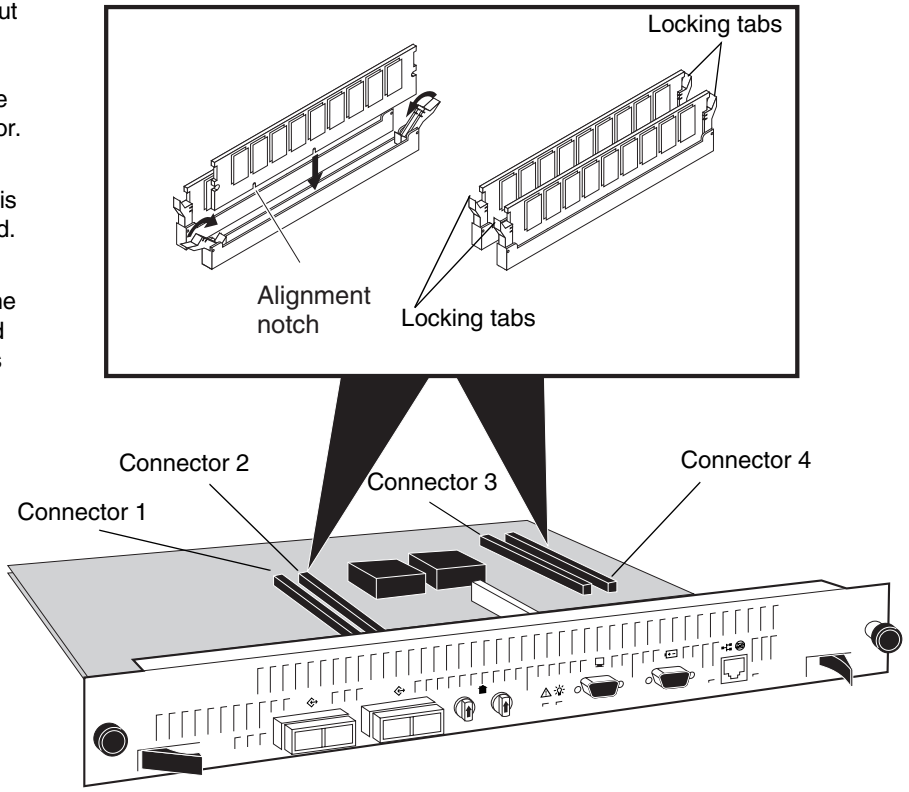


Figure 3-17 Installing the Memory Module on the SP

3. If you want to install the SP, continue to the next section.

Installing an SP or SP Filler Module

SPs, GBICs, and memory modules are separate CRUs. New or replacement SPs are shipped without memory modules or GBICs. When a memory module and/or GBICs are ordered with the SP, they will arrive with the SP; however, they will not be installed on the SP board. Before you install a new or replacement SP, you must install a memory module (see page 3-24).

Installing an SP or SP Filler Module

CAUTION

Handle an SP gently and use an ESD wristband.

1. Perform this step only if you are installing the DPE into an FC-AL environment. Otherwise, continue to the next step.

   If the DPE is operating in a Fibre Channel Arbitrated Loop environment, each SP requires a unique FC-AL address ID on the loop to communicate with a server/host. If you are installing a replacement SP, set its address to be the same as that of the SP you removed. If you are installing an add-on SP, set the address to a unique address on the loop. The FC-AL protocol translates the address ID into an 8-bit arbitrated loop physical address (ALPA). Valid Fibre Channel address IDs range from 0 through 125 (decimal), 0 through 7D (hexadecimal).

   Using the SP FC-AL ID switches, set the FC-AL address ID, as shown in Figure 3-18.

FC-AL address ID (decimal)	Left switch setting	Right switch setting
0	0	0
1	0	1
. . .	. . .	. . .
15	0	F
16	1	0
. . .	. . .	. .
31	1	F
32	2	0
. . .	. . .	. . .
125	7	D

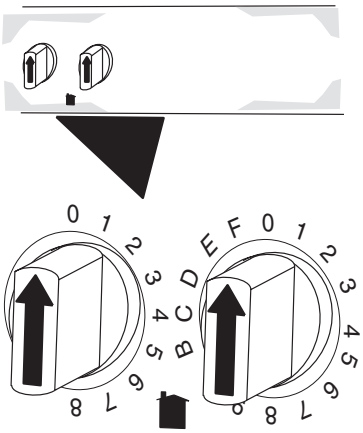


Figure 3-18 Setting the SP Address ID

2. At the back of the deskside DPE, gently insert the SP or filler module as shown below.

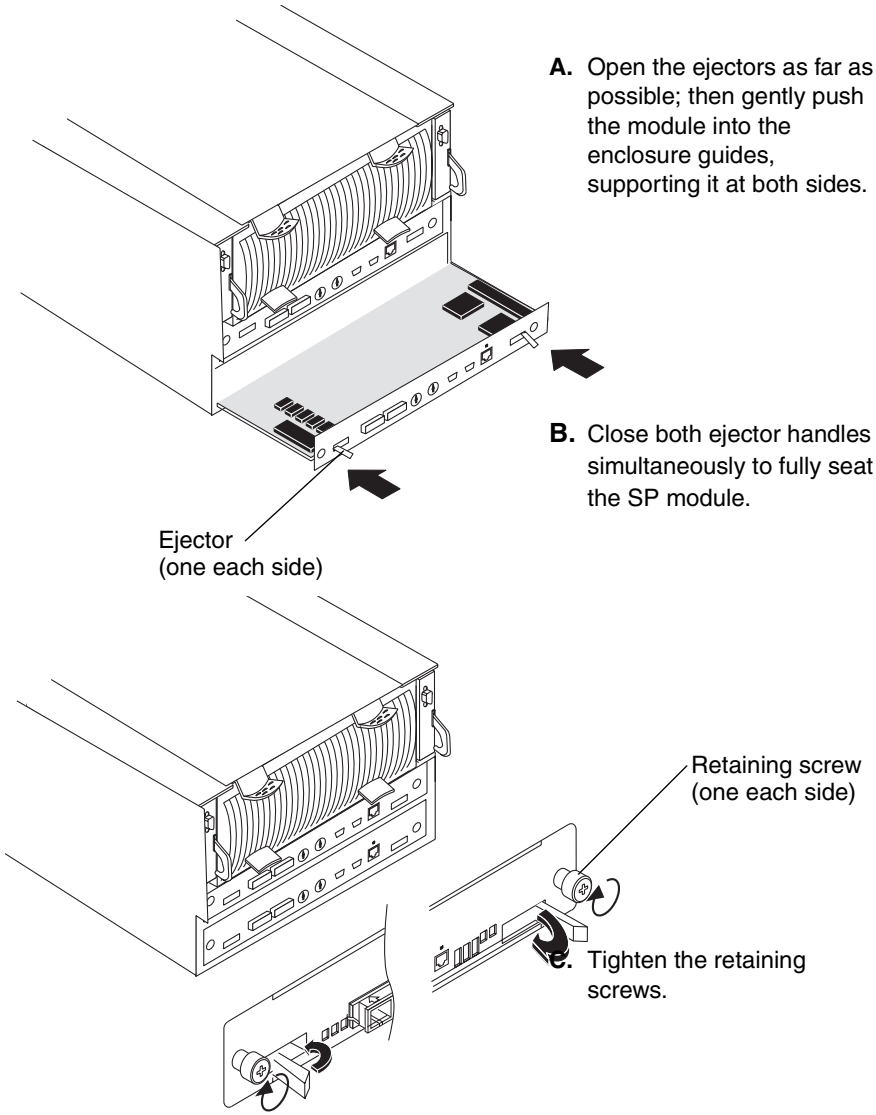

A. Open the ejectors as far as possible; then gently push the module into the enclosure guides, supporting it at both sides.
B. Close both ejector handles simultaneously to fully seat the SP module.
Ejector
(one each side)
Retaining screw
(one each side)
C. Tighten the retaining screws.

Figure 3-19 Installing an SP or SP Filler Module

If you just installed an SP filler module, you are done. Remove and store the ESD wristband. If you just installed a replacement or add-on SP, continue to the next step.

3. Install or reinstall the GBIC connector(s) and the cables on the SP (see pages 3-17 and 3-19).

An SP requires an LCC installed in the DPE and in each expansion DAE on the corresponding loop (for example, SP A requires LCC A, and SP B requires LCC B). If you install an add-on SP, make sure a second LCC is installed in the DPE enclosure and in every DAE enclosure on the corresponding loop.

Replacing or Adding an LCC Module

CAUTION

Handle an LCC gently and use an ESD wristband. Do not remove a faulty LCC until you have a replacement or filler module available.

DPEs with two LCCs should have at least one LCC installed while it is powered up. Try not to remove both LCCs at once.

Removing an LCC

1. If you are adding a new LCC, remove the LCC filler module as shown in Figure 3-21; otherwise continue to the next step.

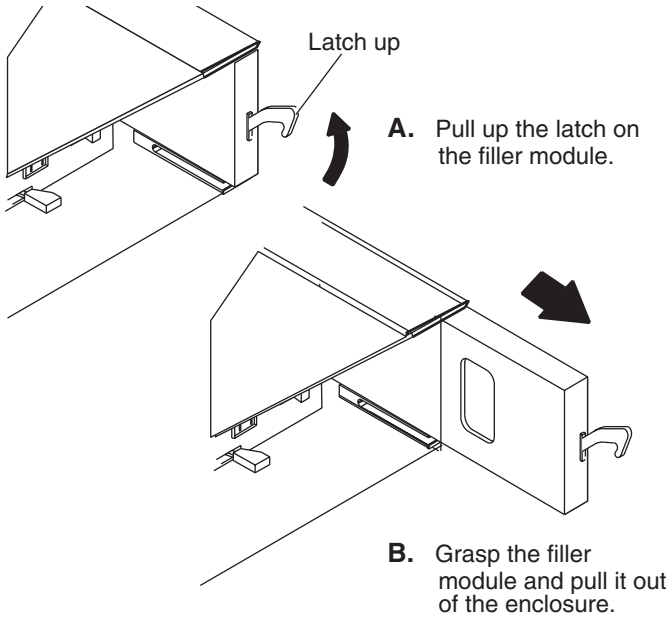


Figure 3-20 Removing an LCC Filler Module

Proceed to the LCC installation procedure (page 3-32) and install the new add-on LCC.

2. If required, remove any cable from the LCC expansion (EXP) port as shown below.

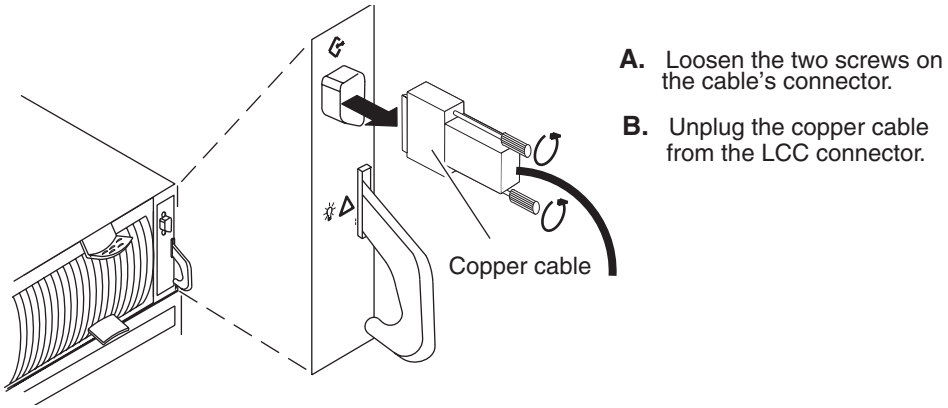
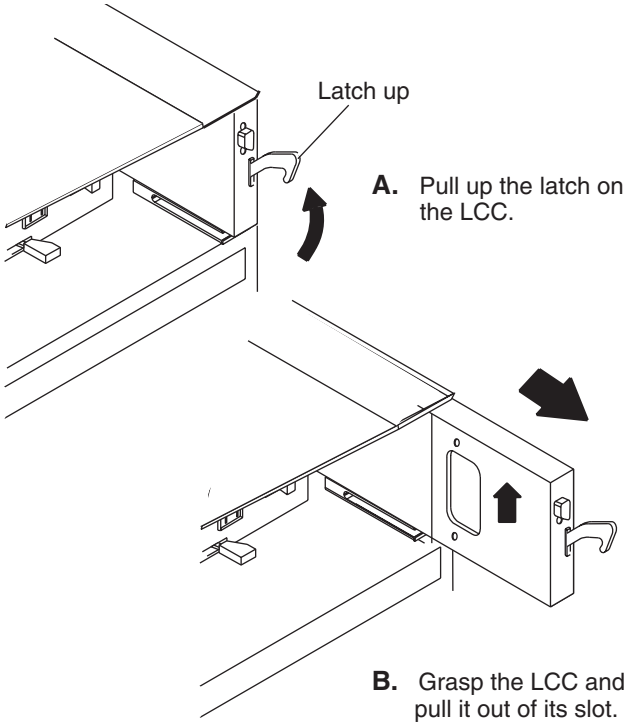


Figure 3-21 Removing a Copper Cable from an LCC

3. Remove the LCC from its slot, as shown below.



After removing an LCC, wait 6 seconds before inserting it or another LCC. The wait allows the Core Software to discover that the LCC has been removed.

Continue to the next section to install the replacement LCC.

Installing an LCC

CAUTION

Handle an LCC gently and use an ESD wristband.

1. *Gently* insert the LCC as shown in Figure 3-22.

DPE LCCs are not the same as DAE LCCs. Replace a failed LCC with one of the same type.

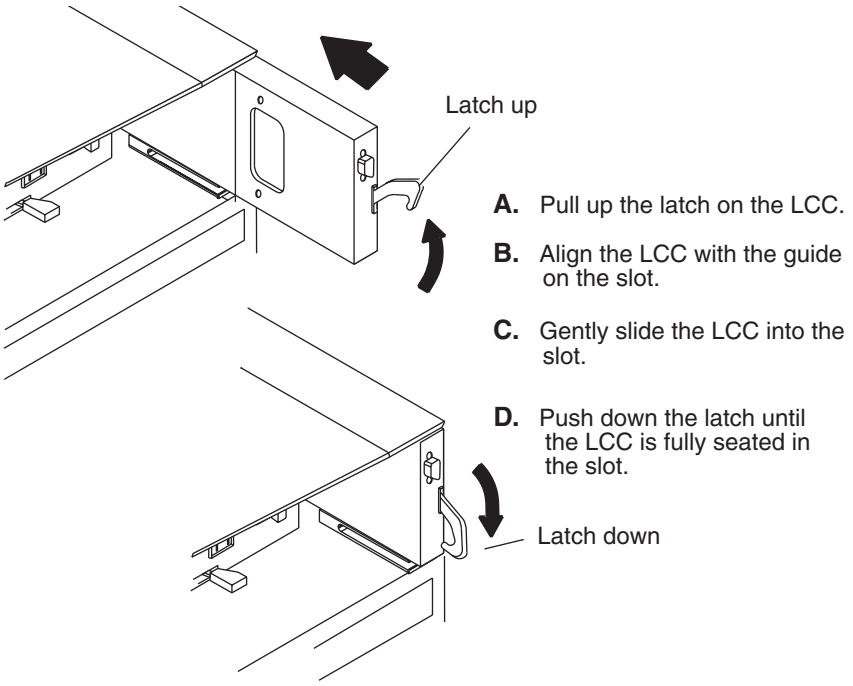
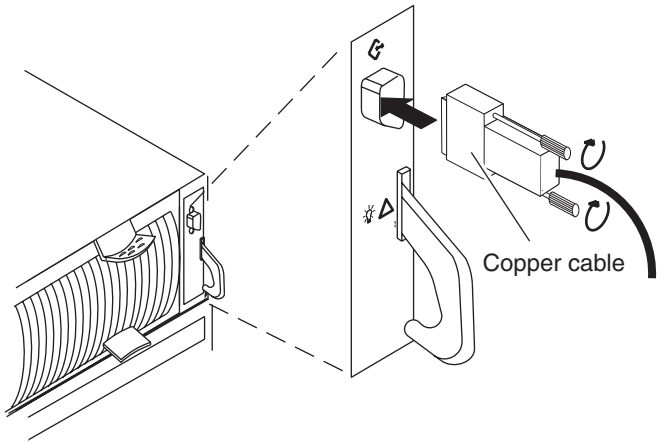

Latch up
A. Pull up the latch on the LCC.
B. Align the LCC with the guide on the slot.
C. Gently slide the LCC into the slot.
D. Push down the latch until the LCC is fully seated in the slot.
Latch down

Figure 3-22 Installing an LCC Module

The LCC Active light turns on. The activity lights of any affected disk modules should resume a steady flicker. If the disk activity lights do not flicker within 6 seconds, remove the LCC and insert it again.

2. If you are installing a replacement LCC, reattach the copper cable on the EXP connector, if required, as shown next.



A. Plug the copper cable into the LCC connector.

B. Tighten the two screws on the cable's connector.

Figure 3-23 Reconnecting a Copper Cable to an Expansion LCC

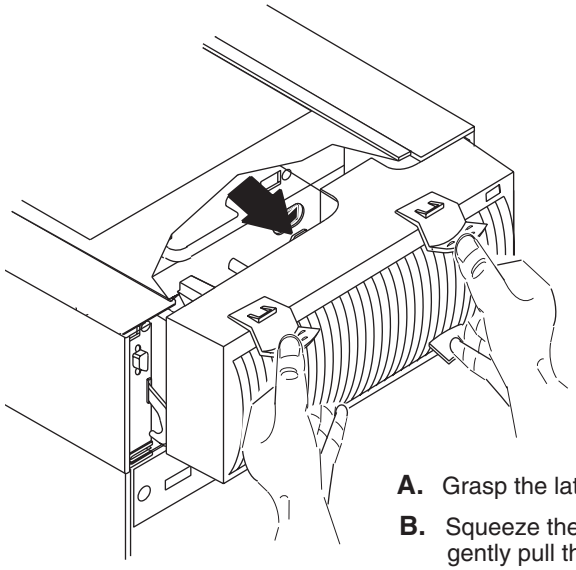
3. You have replaced the LCC. Remove and store the ESD wristband.

Replacing the Drive Fan Pack

CAUTION

Handle a fan pack gently and use an ESD wristband. Do not remove a faulty fan pack until you have a replacement unit available. You can remove the fan pack while the DPE is powered up. If the pack is removed for more than approximately two minutes, the SPs and disk modules power down. The SPs and disk modules will power up when you reinstall the drive fan pack.

Removing the Drive Fan Pack



A. Grasp the latches on the drive fan pack.

B. Squeeze the latches together and gently pull the pack from the enclosure.

Figure 3-24 Removing the Drive Fan Pack

As soon as the pack is disconnected from each power supply, the drive fan pack Check light turns off, if it was not already off; the DPE Check light on the front panel turns on, if it was not already on; and the Cooling Check light on each power supply flashes.

Installing the Drive Fan Pack

You can install the drive fan pack in either horizontal position. For a consistent image with any DAEs installed above the DPE, we recommend that you install it with the status light in the upper-right corner.

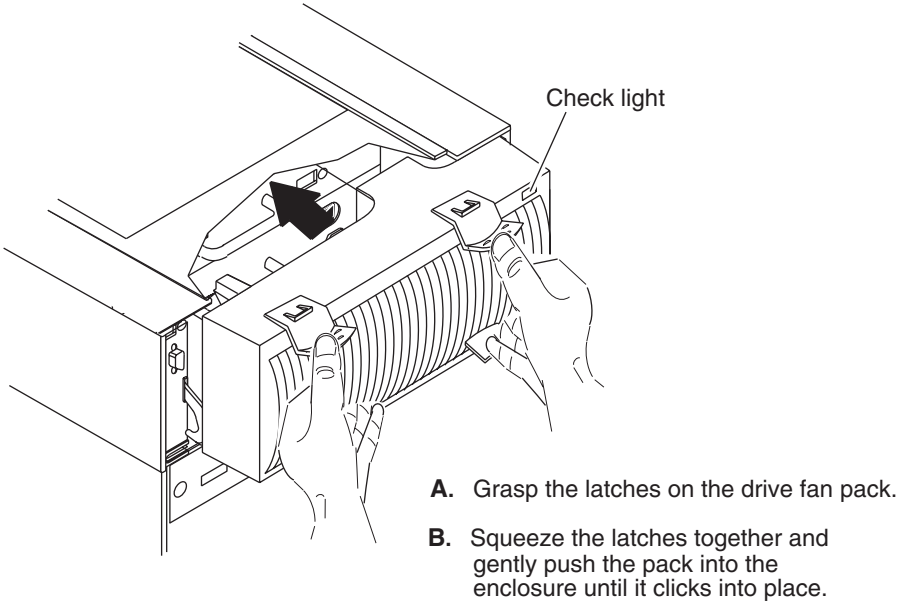

Check light
A. Grasp the latches on the drive fan pack.
B. Squeeze the latches together and gently push the pack into the enclosure until it clicks into place.

Figure 3-25 Installing the Drive Fan Pack

As soon as the pack is in place, the fans start spinning; the DPE Check light turns off if no other CRUs are faulty; and the Cooling Check light on each power supply turns off.

Replacing or Adding a Power-Supply Module

CAUTION

To access a power-supply module, you must remove the drive fan pack. If the drive fan pack is removed for more than two minutes, the SPs and disk modules power down. The SPs and disk modules will power up when you reinstall the drive fan pack.

Handle a power supply gently and use an ESD wristband. Do not remove a power supply until you have a replacement supply or filler module available.

If one power supply is off and the other is on, do *not* turn one on and immediately turn off the other. Instead, turn one on and wait five seconds before turning the other off.

If you are adding a new power supply, remove the power-supply filler module as shown next. If you are replacing a faulty power supply, remove the power-supply module itself as follows.

Removing a Power-Supply Filler Module

1. Remove the drive fan pack as shown on page 3-35.
2. Remove the filler module as shown in Figures 3-26 and 3-27.

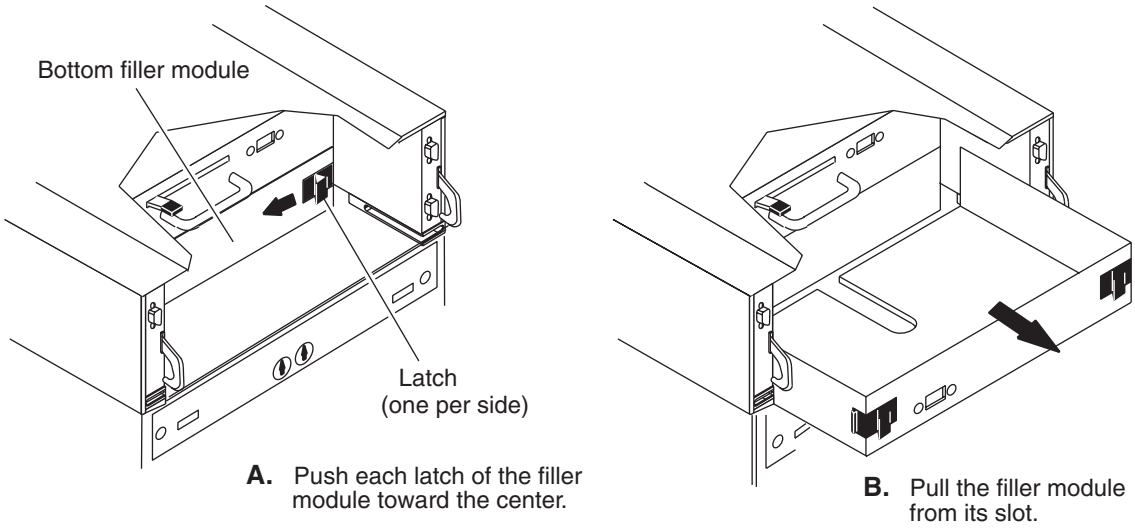

Bottom filler module
Latch
(one per side)
A. Push each latch of the filler module toward the center.
B. Pull the filler module from its slot.

Figure 3-26 Removing the Bottom Filler Module

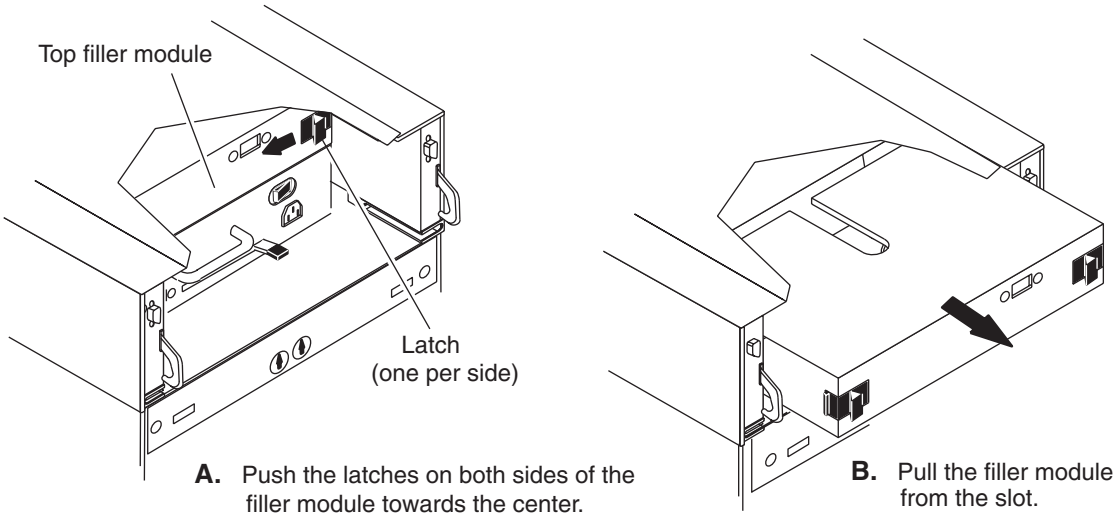

Top filler module
Latch
(one per side)
A. Push the latches on both sides of the filler module towards the center.
B. Pull the filler module from the slot.

Figure 3-27 Removing the Top Filler Module

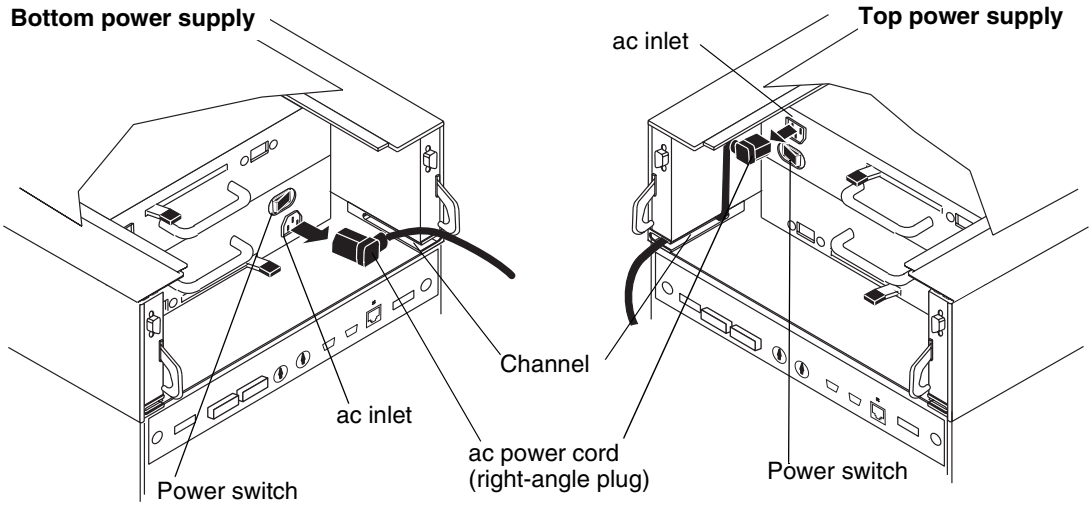
3. Install a power supply in the empty slot as explained on page 3-41.

Removing a Power-Supply Module

CAUTION

Turn off the power supply before unplugging the ac line cord from the supply or removing the supply from the enclosure.

1. Remove the drive fan pack, as shown on page 3-35.
2. Turn off the power supply and unplug its ac line cord as shown next.

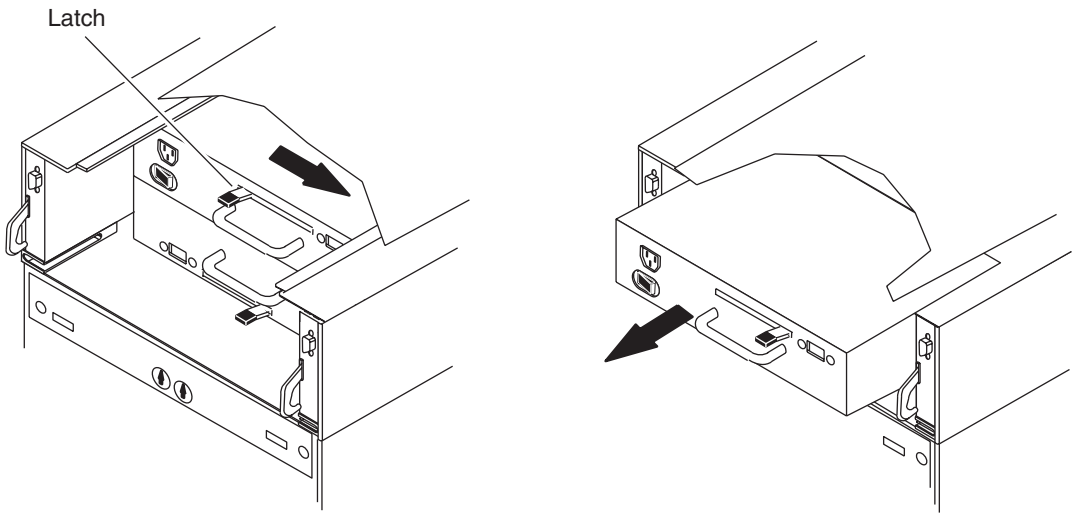


For each power supply to be removed:

a. Set the power supply's switch to off (0).
b. Unplug the ac power cord from the supply's ac inlet.
c. Remove the cord from the enclosure.

Figure 3-28 Turning off a Supply's Power and Unplugging the AC Line Cord

3. Remove the power-supply module, as shown in Figures 3-29 and 3-30.

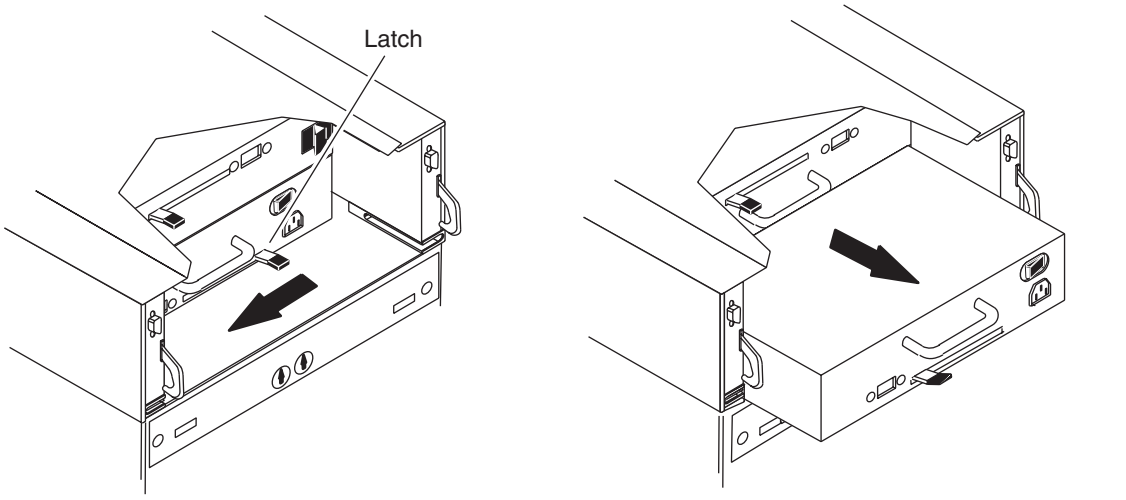


A. With your thumb, push the latch up and then right as far as possible.

You may need to brace your hand against the supply module's handle.

B. Grasp the handle with one hand, and gently pull the module from the enclosure, supporting it with your other hand.

Figure 3-29 Removing the Top Power-Supply Module



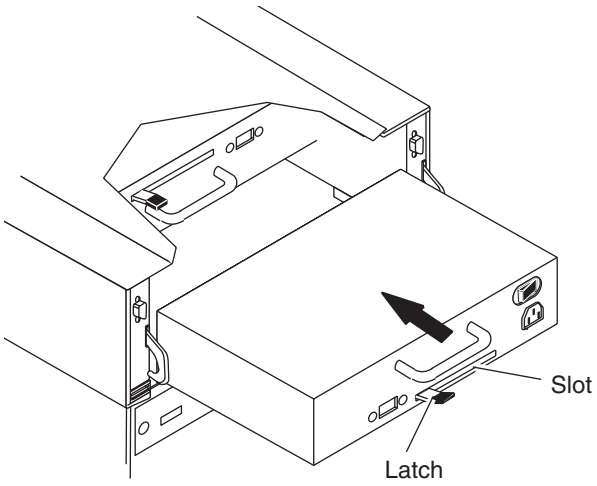
A. With your thumb, push the latch down, and then left, as far as possible.
You may need to brace your hand against the module's handle.

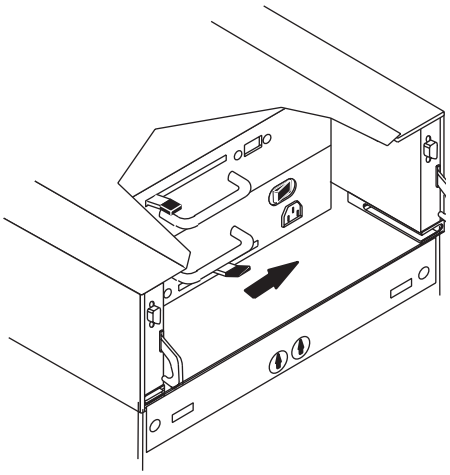
B. Grasp the handle with one hand, and gently pull the module from the enclosure, supporting it with your other hand.

Figure 3-30 Removing the Bottom Power-Supply Module

Installing a Power-Supply Module

The top power supply is inverted with respect to the bottom power supply.





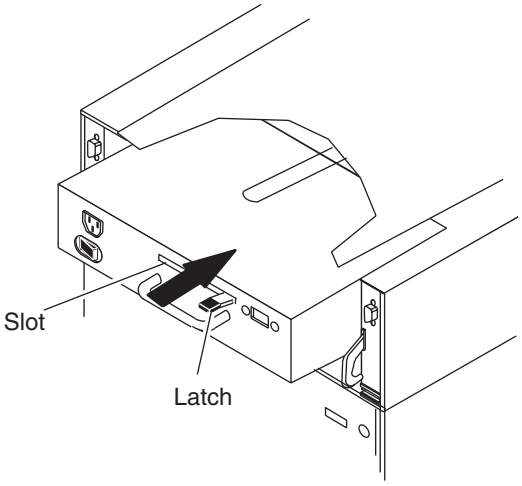
A. Make sure the module's latch is as far left in its slot as possible.

B. Align the supply with the enclosure slot and gently push it into the slot until the latch moves to the middle of the slot.

C. With your thumb, push the latch right until it snaps up.

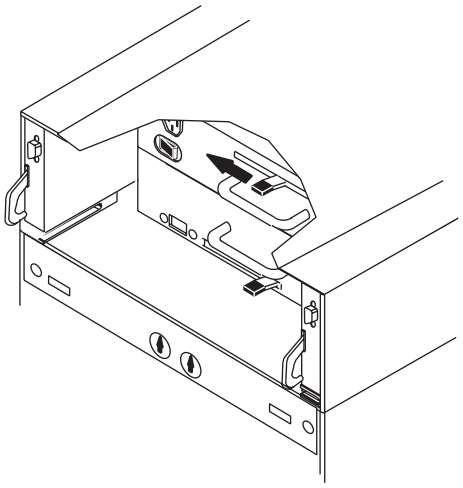
You may need to brace your hand against the module's handle.

Figure 3-31 Installing the Bottom Power Supply



A. Make sure the module's latch is as far right in its slot as possible.

B. Align the module with the slot and gently push it into the slot until the latch moves to the middle of the slot.

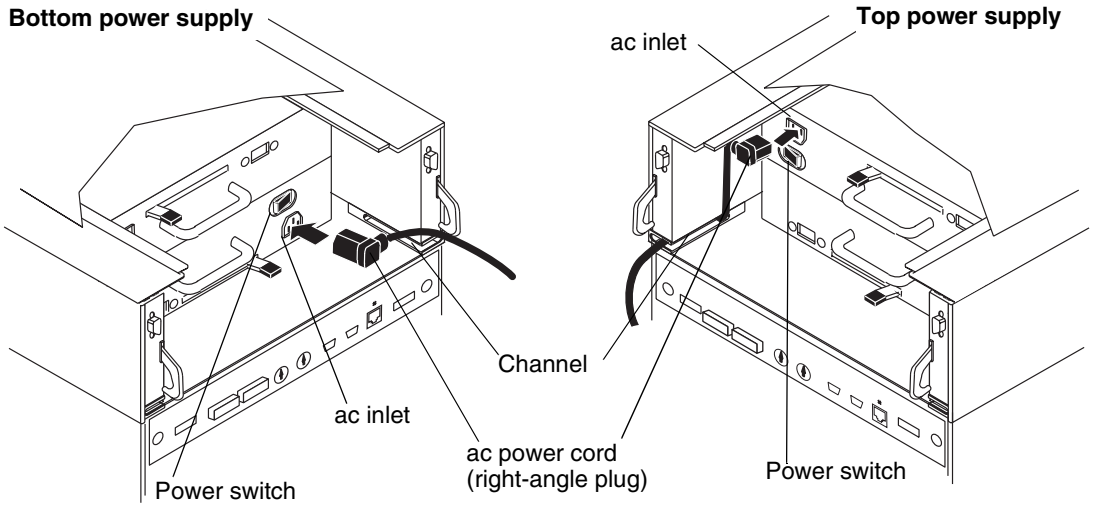


C. With your thumb, push the latch left until it snaps down.

You may need to brace your hand against the supply's handle.

Figure 3-32 Installing the Top Power Supply

4. Plug the ac line cord into the new supply, and turn on its power as shown below.
5. Reinstall the drive fan pack as shown on page 3-35.



For each power supply

a. Plug the right-angle plug on the ac line cord into the supply's ac inlet.

d. Route the cord along the power supply to the side of the enclosure.

The cord must not occupy the space for the drive fan pack.

c. Bend the cord into a U shape and slide the U into the channel so the end of the cable comes out of the channel at the back of the enclosure.

d. Plug the end of the cord into one of the cabinet's power outlets.

e. Set the supply's power switch to the on (1) position.

Figure 3-33 Plugging in the AC Line Cord and Turning on Power

A

Technical Specifications and Operating Limits

This appendix describes the DPE technical specifications, operating limits, and shipping and storage requirements.

Technical Specifications

Technical specifications include power requirements, size, drive, interface, and standards information.

AC Power Requirements

The input current, power (VA), and dissipation per DPE are based on the maximum capability of the power supplies and cooling system to provide internal regulated power. Typical values will be less, depending on the number and manufacturer of disk modules. These values represent either:

- The values for the line cord of a DPE with a single power supply.
- The total values shared by the line cords of two power supplies in the same DPE, with the division between the line cords and supplies at the current sharing ratio.

A failure of one of the two power supplies in the DPE results in the remaining supply and cord supporting the full load. You must use a rackmount cabinet with ac power distribution, and have main branch ac distribution that can handle these values for the DPE and each DAE in the cabinet.

Requirement	Description
ac line voltage	100 to 240 Vac ±10%, single phase, 47 to 63 Hz
ac line current	8.0 A max estimate at 100 V (fully configured)
Power consumption	800 VA max estimate (fully configured)
Power dissipation	792 W max estimate (fully configured)
Power factor	0.99 min at full load, low voltage
Heat dissipation	$2851x10^3$ J/hr (2703 BTU/hr) max estimate
In-rush current	50 A max estimate for 1/2 line cycle, per power supply
ac protection	12 A thermal circuit breaker on each power supply
ac inlet type	IEC320-C14 appliance coupler
Hold-up time	10 ms min at 50 Hz
Current sharing	60% max, 40% min

Size and Weight

Item	Measurement
Height	28.59 cm (11.25 in), 6.5 NEMA units (U), including mounting hardware
Width	44.5 cm (17.5 in); mounting bars fit standard 19-inch NEMA cabinets
Depth	70.02 cm (27.57 in) front door to back of drive fan pack 67.10 cm (26.42 in) enclosure front to back of drive fan pack 64.12 cm (25.24 in) rail front to back of drive fan pack
Weight	DPE with 2 SPs, 2 LCCs, 2 power supplies, and 10 disk modules: 52.0 kg (114.4 lbs) Disk module: 1.0 kg (2.3 lbs) Drive fan pack: 1.8 kg (4.0 lbs) SP: 1.8 kg (4.0 lbs) SP fan pack: 1.8 kg (4.0 lbs) LCC (link control card): 0.8 kg (1.7 lbs) Power supply: 5.4 kg (12.0 lbs)

Drive Type

3.5-inch drives, Fibre Channel interface, 2.54 cm (1.0-inches) or 4.06 cm (1.6-inches) tall.

SP Optical Cabling

The SP optical cable interface to the external Fibre Channel environment is as follows:

Type	50 µm or 62.5 µm, multi-mode, dual SC
Length	50 µm: 2 m (6.6 ft) minimum to 500 m (1,650 ft) maximum 62.5 µm: 2 m (6.6 ft) min to 300 m (985 ft) maximum
Bend radius	3 cm (1.2 in) minimum

LCC Copper Cabling

The DPE's LCC expansion port interface to the DAE is copper cable as follows:

Type	Shielded, 150Ω differential, shield bonded to DB-9 plug connector shell (360x) FC-AL Standard, Revision 4.4 or higher
Length	0.3 m (1 ft) min, 10 m (33 ft) max unequalized between DPE and DAEs

Standards Certification and Compliance

A stand-alone DPE will be tested and certified for compliance with the international environmental and safety specifications listed next. Each DPE will be marked to indicate such compliance and certification as required.

Safety Standards

Standard	Description
CSA 22.2 No. 950	Safety of Information Technology Equipment including Electrical Business Equipment
UL 1950	Safety of Information Technology Equipment including Electrical Business Equipment
CE Mark	European EMC Directive & Low Voltage Directive Requirements. Including: EN 60950 - Safety of Information Technology Equipment including Electrical Business Equipment, TUV-GS, and CB REPORT

EMI Standards

Standard	Description
FCC Part 15	Class A, Radio Frequency Device Requirements
ICES-003	Class A, Interference-Causing Equipments Standard - Digital Apparatus
CE Mark	European EMC Directive & Low Voltage Directive Requirements. Including: CISPR22 - Class A, Limits & Methods of Measurement of Radio Interference Characteristics of ITE and EN55022- Class A.
VCCI	Class A, Voluntary Control Council for Interference
AS/NZS 3548	Class A, Electromagnetic Interference - Limits & Methods of Measurement of ITE
CNS13438	BSMI EMC Requirements

Fibre Channel Related Standards

Standard	Description
Fibre Channel	Physical and signaling interface, FC-PH, Revision 4.4
Fibre Channel	Arbitrated Loop (FC-AL), Revision 4.5
Fibre Channel	Private Loop Direct Attach (PLDA), Revision 1.10
SCSI III	SCSI Enclosure Services (SES), Revision 8a

Operating Limits

The ambient temperature specification is measured at the front door inlet. The site must have air conditioning of the correct size and placement to maintain the specified ambient temperature range. The air conditioning must be able to handle the BTU requirements of the DPEs.

Requirement	Description
Ambient temperature	10°C to 40°C (50°F to 104°F)
Temperature gradient	10°C/hr (50°F/hr)
Relative humidity	20% to 80% noncondensing
Elevation	2438 m (8,000 ft) at 40°C; 3077 m (10,000 ft) at 37°C
Drive module power	25 W drive slot maximum (seeking)

The operating limits listed above for temperature and humidity must not be exceeded inside the closed cabinet in which the DPE and any DAEs are mounted. Mounting equipment in a cabinet directly above or below a DPE does *not* restrict air flow to the DPE because air flows through the DPE from front to back. Cabinet doors must not impede the front-to-back air flow.

Shipping and Storage Requirements

Requirement	Description
Ambient temperature	-40°C to 65°C (-40°F to 149°F)
Temperature gradient	25°C/hr (77°F/hr)
Relative humidity	10% to 90% noncondensing
Elevation	7625 m (25,000 ft.)

Glossary

The terms defined here are important to installing and maintaining a storage system.

A

ALPA (arbitrated loop physical address) An 8-bit address that uniquely identifies an SP (or other device) on an FC-AL loop.

bind In the context of a disk-array storage system, the procedure by which you hardware-format one or more disk modules into one LUN (logical unit) — usually as one several types of RAID group.

B

BTU (British Thermal Unit) A standard measure of a device's heat output.

C

cache See storage-system caching.

CRU (customer-replaceable unit) A hardware component, such as a disk module, that anyone can install or replace.

D

DAE (Disk Array Enclosure) A storage device that includes an enclosure, up to 10 disk modules, one or two Fibre Channel LCCs, and one or two power supplies.

DPE (Disk-Array Processor Enclosure) A storage device that includes an enclosure, up to 10 disk modules, one or two SPs, one or two Fibre Channel LCCs, and one or two power supplies. A DPE can support up to 11 DAEs (each with up to 10 disk modules) in addition to its own 10 disk modules, for a total of 120 disk modules. You can attach a DPE to one or more servers or external hubs in any of many different configurations.

DIMM (dual in-line memory module) A type of memory module used for SP memory.

disk-drive module Another name for disk module.

disk module A self-contained disk drive that slides into one of the slots in the front of the enclosure. The carrier assembly holds the disk drive.

disk unit A short name for physical disk unit.

E

EA (enclosure address) A number, selectable on a DAE front panel, fixed at 0 on a DPE, that helps establish a unique address for each disk module on an FC-AL loop. You must set the EA on each DAE. Since the DPE EA is 0, you might set the first DAE EA to 1, the second to 2, and so on up to a total of 12 enclosures.

EMI (electromagnetic interference) Electronic radiation emitted by an electrical device. The levels of EMI are strictly controlled for data processing equipment. The EMI standards are explained after the Notice page near the beginning of the manual.

ESD (electrostatic discharge) The discharge of an accumulated electrical charge (static). This can severely damage delicate electronic circuits and you should take steps to prevent this, as explained in Chapter 3.

F

FC-AL (Fibre Channel Arbitrated Loop) An arrangement of Fibre Channel stations such that messages pass from one to the next in a ring.

FC-AL address ID A number that identifies a device as a node on a Fibre Channel loop. You select the FC-AL address ID for an SP using switches on the back of the storage system. The default FC-AL address ID for SP A is 0; the default FC-AL address ID for SP B is 1.

Fibre Channel host bus adapter (FC adapter) The name for the printed-circuit board within the computer chassis that allows the server to access the Fibre Channel loop and thus the SP(s).

field-replaceable unit See FRU (field-replaceable unit).

FRU (field-replaceable unit) A hardware assembly that can be replaced on site, instead of at the point of manufacture.

H

HBA (host-bus adapter) Another name for Fibre Channel adapter.

host See server.

hot repair See replace under power.

hub An FC_AL switching device that allows multiple servers and targets, such as storage systems, to connect at a central point. A single hub configuration appears as a single loop.

J

JBOD (just a box of disks) Another application for DAE (Disk Array Enclosure).

L

LCC (link control card) A CRU in an enclosure that connects Fibre Channel signalling to the disk modules. Provides fiber channel connectivity between the SP, disks, and other enclosures. It also provides bypass capability for faulted or missing units, and monitors and controls enclosure elements.

LUN (logical unit) One or more disk modules (each having a head assembly and spindle) bound into a group — usually a RAID Group. The operating system sees the LUN, which includes one or more disk modules, as one contiguous span of disk space.

M

memory module See SP memory module.

N

node Any device with a Fibre Channel interface (such as an HBA in a server or a storage system's SP) that connects to a Fibre Channel loop.

P

PDU (power distribution unit) A device for the distribution of ac line power from one inlet to multiple outlets. Multiple PDUs — in a rackmount cabinet or deskside storage system — provide higher availability since the power continues if one PDU (or its ac source, if the PDUs use separate ac sources) loses power.

physical disk unit Another name for LUN. See LUN (logical unit).

power supply An essential element of the storage-system power supply. A storage system can have two power supplies, PS A and PS B. With two, it can survive failure of one supply. You can replace a power supply under power, without interrupting applications.

PLDA (private loop direct attach) profile A standard for FC-AL disk drives.

R

replace under power The storage system provides replace under power capability, allowing you to replace, for example, a disk module or a fan module without powering down the storage system. Applications continue while you replace the failed module.

S

SCSI (small computer system interface) A well-known protocol and standard for connecting computers and peripheral devices. Some Fibre Channel SPs use a Fibre Channel FC-AL front end to the server and a SCSI back end to the disk modules. The SPs used in DPEs use the Fibre Channel protocol throughout. The array uses SCSI protocol over Fibre Channel.

server In the context of storage systems, a processor that runs an operating system and uses a disk-array storage system for data storage and retrieval.

SFF Small Form Factor Committee

SP (storage processor) A printed-circuit board with processor memory modules and control logic that manages the storage-system I/O between the server FC adapter and the disk modules.

SP memory module A memory module (DIMM) that provides the local storage for an SP.

SPS (standby power supply) A unit that provides temporary backup power in case of a power outage. An SPS is required for storage-system write caching. If power fails, the SPS allows the SP to write the data from its cache to disk. You can replace an SPS under power, without interrupting applications. For SPS installation and cabling information refer to the *Standby Power Supply (SPS) Installation and Maintenance* document (See "Related Documentation" on page xiii.).

storage processor (SP) See SP (storage processor).

storage-system caching The procedure of storing disk-based data in RAM memory (in this case, DIMM memory on an SP) temporarily to save time if the data needs to be accessed or changed again soon.

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